HARBISON-WALKER REFRACTORIES COMPANY

PITTSBURGH PENNSYLVANIA

1918

Catalogue containing useful information in connection with the use of SILICA MAGNESIA CHROME AND FIRE CLAY BRICK and various REFRACTORIES

as furnished by the
Harbison-Walker
Refractories Co.
Pittsburgh, Pa.

PLANTS IN

Pennsylvania, Ohio, Indiana, Alabama and Kentucky.

SALES OFFICES AT

Pittsburgh, Chicago, Philadelphia, New York, Birmingham, Cleveland, Buffalo and Montreal.

PREFACE

GOOD material is the factor of supreme importance in all processes of manufacture. During the growth and expansion of the fire brick business from small beginnings to the present output — corresponding to the growth and demands of the iron, steel and other important industries — it has been the aim of this Company to maintain the lead in supplying all demands for high grade fire brick and refractory material. To this end, all clay deposits, seemingly worthy of investigation, have been core drilled, the best experts employed and record maps placed on file, enabling the Company to open mines in the irregular formations of fire clay with exact knowledge of what would be found. This work has been going on systematically for over thirty years.

The results enable us to offer the following unrivaled list of well known brands of fire brick. While many of the brands are specially fitted for special work, others are not widely dissimilar, but owing to location of plants one brand may obtain a more favorable freight rate in a given case.

Correspondence or an interview will determine, according to circumstances, which is the most suitable brand in use. With a broad experience in the business, with a wide range of records for reference and the most extensive natural resources upon which to draw, it is

reasonable for our customers to assume that they will get reliable advice and intelligent handling of their orders, however large or small.

Among the brands manufactured are many that have been favorably known for forty years or more, and have proved their quality by their unexcelled records.

Any inquiry as to the brand best suited for the work under consideration will be gladly and promptly answered, giving the fullest data as to the applicability of the material to the particular needs.

These records and data embrace not only blast furnace and stove work, the open hearth, soaking pit, by-product coke oven, copper smelting furnaces and the malleable plant, but every type of furnace such as cupolas, glass tanks, boiler settings, lime and cement kilns, heating furnaces, bee-hive and longitudinal coke ovens, electric furnaces, zinc oxide, roasting and spelter furnaces, etc.

It is our belief that the exceptional results secured by these brands, in such furnaces as the above, is in no small measure due to the emphasis always laid on the quality of the raw stock. Without it no skill is sufficient to produce a high grade product.

BRANDS

PITTSBURGH DEPARTMENT:

Benezet	Stove Benezet	H. Clarion
Benezet Hearth and Bosh	Stove Clarion	M. Clarion
Benezet Inwall	Stove No. 2 Star	Bauxite
Benezet Top	Pipe Benezet	Star Silica

CLEARFIELD AND CAMBRIA COUNTY DEPARTMENT:

Woodland	Stove Woodland	H.-W. R. Co. Furnace
Woodland Hearth and Bosh	Stove Bradford	Tyrone
Woodland Inwall	Stove Tyrone	H.-W. Liners
Woodland Top	Pipe Woodland	

CLEARFIELD FIRE BRICK COMPANY DEPARTMENT:

Clearfield-S.	Clearfield Top	Stove Clearfield
Clearfield Hearth and Bosh	C. F. B.	Stove C. F. B.
Clearfield Inwall		

REESE DEPARTMENT:

Phoenix	Wallace	W. F. B.

PHILIPSBURG DEPARTMENT:

Wigton Steel

CLINTON COUNTY DEPARTMENT:

Munro	C. Tyrone	Eureka
–Munro	C. Eureka	Widemire
H.-W. Special	Alusil	

PORTSMOUTH-KENTUCKY DEPARTMENT:

H. & W. Co. High Grade	Franklin Crown	Malleable
H. & W. Co. Hearth and Bosh	C. Franklin Crown	C. O. Crown
H. & W. Co. Inwall	Anglo-Saxon	C. O. Liner
H. & W. Co. Top	R. Jenkins	Scioto Star
H. & W. Co. No. 1	Royal Star	Webster

BIRMINGHAM DEPARTMENT:

Southern Star Silica	Southern	Wylam
XX Southern		

MT. UNION DEPARTMENT:

Star Silica

CHICAGO DEPARTMENT:

Western Star Silica

LAYTON DEPARTMENT:

XX Silica	H.-W. Crown

BASIC DEPARTMENT:

H.-W. R. Co. (Magnesia Brick)	H.-W. R. Co. (Chrome Brick)

STANDARD 9-INCH SIZES CARRIED IN STOCK

9-INCH STRAIGHT

9 x 4½ x 2½″

SMALL 9-INCH BRICK

9 x 3½ x 2½″

SPLIT BRICK

9 x 4½ x 1¼″

2-INCH BRICK

9 x 4½ x 2″

SOAP

9 x 2¼ x 2½″

CHECKER

9 x 2¾ x 2¾″

JAMB BRICK

9 x 4½ x 2½″

STANDARD 9-INCH SIZES CARRIED IN STOCK

No. 1 ARCH
76 Brick to the Circle
4′ 3″ Inside Diameter
9 x 4½ x 2½ x 2⅛″

No. 2 ARCH
38 Brick to the Circle
1′ 9″ Inside Diameter
9 x 4½ x 2½ x 1¾″

No. 3 ARCH
19 Brick to the Circle
6″ Inside Diameter
9 x 4½ x 2½ x 1″

No. 1 KEY
113 Brick to the Circle
12′ Inside, 13′ 6″ Outside Diam.
9 x 4½ x 4 x 2½″

No. 2 KEY
57 Brick to the Circle
5′ 3″ Inside, 6′ 9″ Outside Diam.
9 x 4½ x 3½ x 2½″

No. 3 KEY
38 Brick to the Circle
3′ Inside, 4′ 6″ Outside Diam.
9 x 4½ x 3 x 2½″

No. 4 KEY
25 Brick to the Circle
1′ 6″ Inside, 3′ Outside Diam.
9 x 4½ x 2¼ x 2½″

See Table Pages 127 and 128

STANDARD 9-INCH SIZES CARRIED IN STOCK

SIDE SKEW

9 x 4½ x 2½ x 1¾"

EDGE SKEW

9 x 4½ x 1½ x 2½"

END SKEW

9 x 6⅛ x 4½ x 2½"

FEATHER-EDGE

9 x 4½ x 2½ x ⅛"

NO. 1 NECK

9 x 4½ x 3½ x 2½ x ⅝"

NO. 2 NECK

9 x 4½ x 2½ x 1½ x ⅝"

NO. 3 NECK

9 x 4½ x 2½ x ⅝"

STANDARD 9-INCH SIZES CARRIED IN STOCK

No. 1 WEDGE

91 Brick to the Circle
4′ 6″ Inside, 6′ Outside Diam.
9 x 4½ x 2½ x 1⅞″

No. 2 WEDGE

57 Brick to the Circle
2′ 3″ Inside, 3′ 9″ Outside Diam.
9 x 4½ x 2½ x 1½″

24-INCH CIRCLE BRICK

12 Brick to the Circle
24″ Inside, 33″ Outside Diam.
9 x $6\frac{9}{16}$ x 4½ x 2½″

36-INCH CIRCLE BRICK

16 Brick to the Circle
36″ Inside, 45″ Outside Diam.
9 x $7\frac{3}{16}$ x 4½ x 2½″

48-INCH CIRCLE BRICK

20 Brick to the Circle
48″ Inside, 57″ Outside Diam.
9 x $7\frac{9}{16}$ x 4½ x 2½″

60-INCH CIRCLE BRICK

24 Brick to the Circle
60″ Inside, 69″ Outside Diam.
9 x $7\frac{11}{16}$ x 4½ x 2½

72-INCH CIRCLE BRICK

28 Brick to the Circle
72″ Inside, 81″ Outside Diam.
9 x 8 x 4½ x 2½

See Table Pages 125 and 139

SPECIAL SHAPES

ON the following pages are shown special shapes designed for various standard and special types of furnaces. Some of these commonly used by the trade are carried in stock.

BUNG ARCH

9 x 4½ x 2½ x 2⅜″

No. 3 WEDGE

57 Brick to the Circle
3′ Inside, 4′ 6″ Outside Diam.
9 x 4½ x 3 x 2″

KEY WEDGE

9 x 4½ x 3 x 2½ x 1½″

LARGE 9-INCH STRAIGHT

9 x 6¾ x 2½″

LARGE 9-INCH No. 1 WEDGE

91 Brick to the Circle
4′ 6″ Inside, 6′ Outside Diam.
9 x 6¾ x 2½ x 1⅞″

LARGE 9-INCH No. 2 WEDGE

57 Brick to the Circle
2′ 3″ Inside, 3′ 9″ Outside Diam.
9 x 6¾ x 2½ x 1½″

BLAST FURNACE SHAPES

13½-INCH STRAIGHT
13½ x 6 x 3″

13½-INCH No. 1 KEY
85 Brick to the Circle
11′ 3″ Inside Diameter
13½ x 6 x 5 x 3″

13½-INCH No. 2 KEY
52 Brick to the Circle
6′ Inside Diameter
13½ x 6 x 4⅜ x 3″

9 X 6 INCH STRAIGHT
9 x 6 x 3″

9 X 6 INCH No. 1 KEY
91 Brick to the Circle
13′ Inside Diameter
9 x 6 x 5⅜ x 3″

9 X 6 INCH No. 2 KEY
47 Brick to the Circle
6′ Inside Diameter
9 x 6 x $4\frac{13}{16}$ x 3″

The above shapes are also made in 2½″ thickness when so desired.

See Table Pages 131 and 133

BLAST FURNACE BRICK FOR GAS FLUES

13½ X 9 INCH ARCH

For 3, 4 and 5′ Inside Diameter
For 3′—13½ x 9 x 3½ x 2¼″
For 4′—13½ x 9 x 3½ x $2\frac{11}{32}$″
For 5′—13½ x 9 x 3½ x $2\frac{11}{16}$″

13½ X 9 INCH STRAIGHT

For enlarging above circles
13½ x 9 x 3½″

9 X 9 INCH ARCH

For 3, 4 and 5′ Inside Diameter
For 3′—9 x 9 x 3½ x 2¼″
For 4′—9 x 9 x 3½ x $2\frac{11}{32}$″
For 5′—9 x 9 x 3½ x $2\frac{11}{16}$″

9 X 9 INCH STRAIGHT

For enlarging above circles
9 x 9 x 3½″

See Table Page 135

MALLEABLE FURNACE SHAPES

No. 101 SQUARE BUNG
13 x 4½ x 3″

No. 102 ANGLE BUNG
12¾ x 11⅜ x 4½ x 3″

No. 103 ARCH BUNG
5′ 3″ Inside Diam.
13 x 4½ x 3 x 2⅝″

No. 104 ARCH ANGLE BUNG
5′ 3″ Inside Diam.
12¾ x 11⅜ x 4½ x 3 x 2⅝″

POTTERY KILN TILE

FLATBACK
9 x 6 x 2½″

FLATBACK ARCH
9 x 6 x 3½ x 2½″
2′ 6″ Inside Diam.

CUPOLA SHAPES

30-INCH CUPOLA BLOCK

15 Brick to the Circle
30″ Inside, 42″ Outside Diam.
9 x 6 1/16 x 6 x 4″

36-INCH CUPOLA BLOCK

17 Brick to the Circle
36″ Inside, 48″ Outside Diam.
9 x 6¾ x 6 x 4″

48-INCH CUPOLA BLOCK

21 Brick to the Circle
48″ Inside, 60″ Outside Diam.
9 x 7 1/16 x 6 x 4″

60-INCH CUPOLA BLOCK

25 Brick to the Circle
60″ Inside, 72″ Outside Diam.
9 x 7½ x 6 x 4″

72-INCH CUPOLA BLOCK

29 Brick to the Circle
72″ Inside, 84″ Outside Diam.
9 x 7 11/16 x 6 x 4″

84-INCH CUPOLA BLOCK

33 Brick to the Circle
84″ Inside, 96″ Outside Diam.
9 x 7⅞ x 6 x 4″

See table page 135

HEXAGON STOVE SHAPES

12 X 13 INCH HEXAGON

9″ Diameter Flue

12 x 7½ x 9″

6 X 13 INCH HEXAGON

For Breaking Joints

and Finishing Top

6 x 7½ x 9″

BEEHIVE COKE OVEN SHAPES

H.-W. CROWN

9 x 4½ x 4 x 2½ x 2¼″

H.-W. CROWN SOAP

9 x 2½ x 2¼ x 2¼ x 2$\frac{1}{16}$″

H.-W. LINER

9 x 4½ x 4 x 2½″

DOOR BLOCK

4½ x 4½ x 4½″

BOTTOM TILE NO. 14

12 x 12 x 3″
also
12 x 12 x 4″

BEEHIVE COKE OVEN SHAPES

SHAPE NO. 66 OR 12-PIECE TRUNNEL

23 x 21 x 10 x 13 x 14″
12-Piece Section
10 x $3\frac{3}{8}$ x $5\frac{13}{16}$ and $3\frac{5}{8}$ x $5\frac{7}{16}$

TRUNNEL HEAD NO. 42

Either in 4 Sections or
1 Piece
24 x 22 x 9 x 14 x 15″

RING

Either in 4 Sections or
1 Piece
24 x 8 with 12″ hole

See pages 77 to 91 inclusive for coke oven plans

LONGITUDINAL COKE OVEN SHAPES

SHAPE No. 24 OR
LINER BLOCK
15 x 9 x 4½"

SHAPE No. 50
OR
RING WALL BLOCK
18 x 16 x 9 x 8"

SHAPE No. 164 OR
4 PIECE
TRUNNEL HEAD
24 x 24 x 17⅞ x 17⅞ x 12 1/16"
With 13 to 14" Hole

REGENERATOR TILE

The following sizes are generally used.

16 x 6 x 3	21 x 6 x 3	24 x 9 x 3
18 x 6 x 3	22 x 6 x 3	26 x 9 x 3
20 x 6 x 3	24 x 6 x 3	

All other sizes made to order

SPECIAL CHECKER

10½ x 4½ x 4½"

STOCK HOLE TILE

18 x 9 x 4"

BRIDGE BLOCK

13 x 6½ x 3"

ROTARY KILN SHAPES

54-INCH ROTARY KILN BLOCK

26 Brick to the Circle
54" Inside, 72" Outside Diameter
9 x 9 x 6¾ x 4"

60-INCH ROTARY KILN BLOCK

28 Brick to the Circle
60" Inside, 78" Outside Diameter
9 x 9 x 6 11/16 x 4"

66-INCH ROTARY KILN BLOCK

30 Brick to the Circle
66" Inside, 84" Outside Diameter
9 x 9 x 7 1/16 x 4"

72-INCH ROTARY KILN BLOCK

31 Brick to the Circle
72" Inside, 90" Outside Diameter
9 x 9 x 7 1/16 x 4"

78-INCH ROTARY KILN BLOCK

78" Inside, 96" Outside Diameter
34 to a Circle
9 x 9 x 7 3/16 x 4"

ROTARY KILN SHAPES

84-INCH
ROTARY KILN BLOCK

36 Brick to the Circle
84″ Inside, 102″ Outside Diameter
9 x 9 x 7$\frac{11}{32}$ x 4″

60 X 6-INCH
ROTARY KILN BLOCK

25 Brick to the Circle
60″ Inside, 72″ Outside Diameter
9 x 6 x 7½ x 4″

72 X 6-INCH
ROTARY KILN BLOCK

30 Brick to the Circle
72″ Inside, 84″ Outside Diameter
9 x 6 x 7$\frac{17}{32}$ x 4″

FEED END BLOCK

76 Brick to the Circle
8′ 0″ Inside Diameter
12 x 6 x 4½ x 4″

Any shapes desired will be made to order

RECUPERATOR FLUE TILE

Shapes similar to the above cut are largely used in various types of recuperators in furnace and gas bench work. We are especially equipped for producing this class of material.

SHAPES FOR CONVERTER BOTTOMS

We illustrate above several shapes for converter bottoms; other shapes will be made to order.

TYPICAL LOCOMOTIVE ARCH TILE

All types of locomotive tile made to order.

We furnish locomotive tile to many of the largest and most important railway systems in the country.

BOILER SHAPES

BAFFLE TILE

12 x 12 x 2″
also
12 x 10 x 2″
12 x 15 x 2″
12 x 18 x 2″

SPECIAL
ARCH AND JAMB

for
20-inch door
also
24-inch and 30-inch doors

BOILER SHAPES
TONGUE AND GROOVE FIRE BOX BLOCKS

A—Length of Grate   C—Thickness of Blocks
B—Width of Grate   D—Height of Blocks

The Standard sizes of blocks are usually 12 inches high and either 8 or 9 inches thick. Any special sizes made to order.

To send an inquiry or order merely give us the above dimensions and state how many sets are needed.

BOILER SHAPES
DOOR ARCH AND JAMB BLOCKS

A SET FOR SINGLE DOOR ARCH AND JAMB
STRAIGHT OPENING

A—Width of Door Opening
B—Width of Jamb
C—Height at Center of Door
D—Depth of Dead Plate
E—Total Height of Arch and Jamb
F—Height at Side of Door

FOR DOORS WITH FLARED OPENING SEE PAGES 31 AND 32

To send an order or inquiry merely give us the above dimensions and state how many sets are needed.

BOILER SHAPES
DOOR ARCH AND JAMB BLOCKS

A SET FOR DOUBLE DOOR ARCH AND JAMB
STRAIGHT OPENING

A—Width of Door Opening
B—Distance between Doors
C—Height at Center of Doors
D—Depth of Dead Plate
E—Total Height of Arch and Jamb
F—Height at Side of Door

FOR DOORS WITH FLARED OPENING SEE PAGES 31 AND 32

To send an inquiry or order merely give us the above dimensions and state how many sets are needed.

BOILER SHAPES
DOOR ARCH AND JAMB BLOCKS

A SET FOR SINGLE DOOR ARCH AND JAMB
FLARED OPENING

A—Width of Door Opening at Front
B—Width of Jamb
C—Height at Center of Door at Front
D—Depth of Dead Plate
E—Total Height of Arch and Jamb
F—Height at Side of Door
G—Width of Door Opening at Back
H—Height at Center of Door at Back

FOR DOORS WITH STRAIGHT OPENING SEE PAGES 29 AND 30

To send an inquiry or order merely give us the above dimensions and state how many sets are needed.

BOILER SHAPES
DOOR ARCH AND JAMB BLOCKS

A SET FOR DOUBLE DOOR ARCH AND JAMB
FLARED OPENING

A—Width of Door Opening at Front
B—Distance between Doors
C—Height at Center of Door at Front
D—Depth of Dead Plate
E—Total Height of Arch and Jamb
F—Height at Side of Door
G—Width of Door Opening at Back
H—Height at Center of Door at Back

FOR DOORS WITH STRAIGHT OPENING SEE PAGES 29 AND 30

To send an inquiry or order merely give us the above dimensions and state how many sets are needed.

TYPICAL BAFFLE AND BACK COMBUSTION ARCH TILES

OTHER SHAPES MADE TO ORDER

TYPICAL STOKER ARCH TILE

OTHER SHAPES MADE TO ORDER

SPECIAL SHAPES—SILICA

STANDARD 9-inch sizes are identical with those shown for clay, pages 8 to 11 inclusive. Special shapes, some of which we carry in stock, are shown on the following pages; others will be made to order.

3-INCH SERIES

12 X 6 X 3 INCH STRAIGHT

12 X 3 INCH No. 1 WEDGE
12 x 6 x 3 x 2½″
10′ Inside Diameter

12 X 3 INCH No. 2 WEDGE
12 x 6 x 3 x 2″
4′ Inside Diameter

12 X 9 X 3 INCH SOAP

12 X 3 INCH No. 1
WEDGE SOAP
12 x 9 x 3 x 2½″
10′ Inside Diameter

See 2½-Inch series, pages 36 and 37

SPECIAL SHAPES-SILICA

3-INCH SERIES—CONTINUED

12 X 3 INCH No. 2 WEDGE SOAP

12 x 9 x 3 x 2″
4′ Inside Diameter

12 X 3 X 3 INCH SOAP

12-INCH No. 1 KEY

12 x 6 x $5\frac{1}{2}$ x 3″
22′ Inside Diameter

12-INCH No. 2 KEY

12 x 6 x 5 x 3″
10′ Inside Diameter

$2\frac{1}{2}$-INCH SERIES

12 X 6 X $2\frac{1}{2}$ INCH STRAIGHT

12 X $2\frac{1}{2}$ INCH No. 1 WEDGE

12 x 6 x $2\frac{11}{16}$ x $2\frac{1}{2}$″
26′ 9″ Inside Diameter

State whether $2\frac{1}{2}$ or 3-inch series is desired

SPECIAL SHAPES—SILICA

$2\frac{1}{2}$-INCH SERIES—CONT.

12 X 9 X $2\frac{1}{2}$ INCH SOAP

12 X $2\frac{1}{2}$ INCH No. 1 WEDGE SOAP

12 x 9 x $2\frac{11}{16}$ x $2\frac{1}{2}$"
26' 9" Inside Diameter

12-INCH No. 1 ARCH

75 Brick to the Circle
5' Inside, 6' Outside Diam.
12 x 6 x 3 x $2\frac{1}{2}$"

12-INCH No. 2 ARCH

75 Brick to the Circle
4' Inside, 5' Outside Diam.
12 x 6 x $2\frac{1}{2}$ x 2"

$13\frac{1}{2}$-INCH BINDER BRICK

$13\frac{1}{2}$ x $4\frac{1}{2}$ x $2\frac{1}{2}$"

$13\frac{1}{2}$-INCH STRAIGHT

$13\frac{1}{2}$ x 6 x $2\frac{1}{2}$"

See 3-inch series, pages 35 and 36

SIEMENS STEEL FURNACE BLOCKS

IN SILICA

See pages 40 to 43 inclusive for plans of crucible furnaces

SIEMENS STEEL FURNACE BLOCKS
IN SILICA

SIEMENS STEEL FURNACE COVER BRICK
MADE IN FIRE CLAY ONLY

BEVEL COVER
12 x 4 x 3¾ x 3″

SQUARE COVER
12 x 4 x 3″

ARCH COVER
12 x 4 x 3 x 2½″

SPECIAL COVER
12 x 4½ x 3 x 2½″

SIEMENS CRUCIBLE STEEL MELTING FURNACE

ON page 41 is a cut of this furnace, showing the shapes of brick commonly used in building it, and on pages 38 and 39 will be found cuts of each special shape indicated in this drawing, all of which we keep in stock.

The records of Star Silica amply justify its envious reputation in steel melting furnace practice. Our "WOODLAND" brand of fire brick secured the greater part of this trade when it was first introduced, and held 90 per cent. of it for 25 years, on its merits, until the "STAR SILICA" gradually replaced it. "WOODLAND" brand is still used by some companies who prefer clay brick to silica brick in crucible steel melting furnaces.

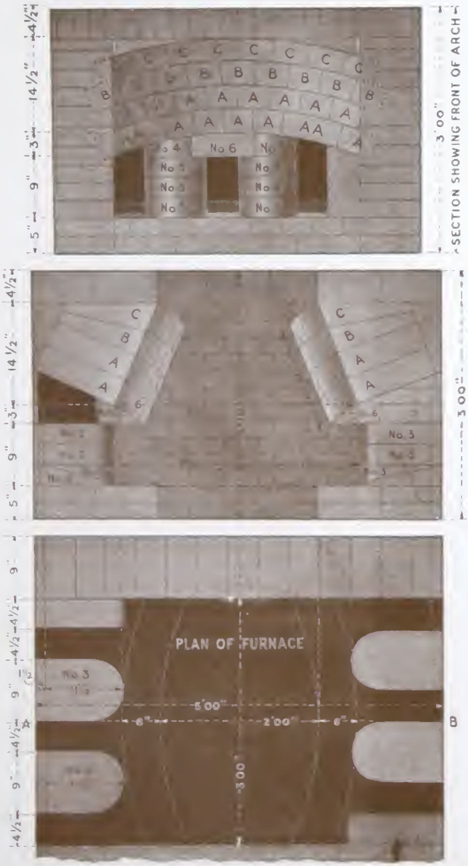
LIST OF SHAPES REQUIRED FOR ONE 6-POT FURNACE

Shape No.	No. Pieces	Where Used
A	30	1st and 2d courses in wall
AA	4	Over port openings
B	18	3d course in wall
C	20	4th course in wall
2	6	Between piers
3	12	Pier brick
4	2	On tops of piers
5	2	On tops of piers
6	2	On tops of piers
9-inch straights,	800	

Orders for these furnaces should specify whether or not 9-inch straights are to be included.

We carry the above shapes in "STAR SILICA" and "WOODLAND" brands.

PLAN OF SIEMENS STEEL FURNACE



OUR PLAN OF SHAPES

FOR SIEMENS CRUCIBLE STEEL MELTING FURNACE

ON page 43 will be found a system of shapes for above furnace designed by ourselves. The plan differs from others in having the side walls, or walls over the ports, built with horizontal joints, thus doing away with the arched side walls.

The advantages are that having all joints or courses of brick horizontal, the side walls are not inclined to pitch into the furnace, as with the old style of shapes; all the shapes extend back to the breast wall, thus making a tight joint the full height of the furnace and preventing the gas from working up between the breast wall and the furnace wall. With the solid bearing, the settling will be uniform throughout the furnace, thus avoiding the opening or shattering of the walls by unequal settling. The shapes being of simple pattern, a mason can build a furnace with these shapes in less time than is required with others. They are made in fire clay brick only.

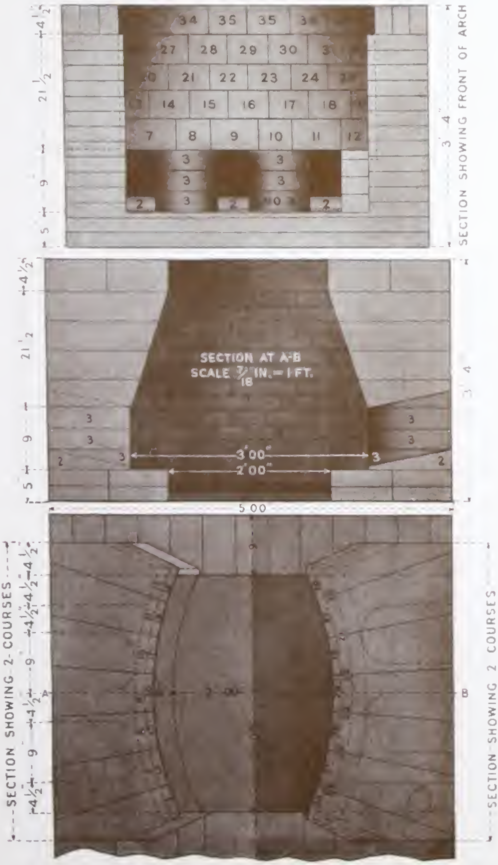
IT REQUIRES THE FOLLOWING SHAPES TO BUILD ONE SIX-POT HOLE

No. 2	6	pieces	No. 33 .	4	pieces
No. 3	12	"	No. 34 .	4	"
Nos. 7 to 32, inclusive	2	" each	No. 35 .	4	"
No. 33	4	"	9-inch .	800	"

Customers should always order extra as many 9-inch straights as required.

OUR PLAN OF SHAPES FOR SIEMENS CRUCIBLE STEEL MELTING FURNACE

MADE IN FIRE CLAY BRICK ONLY



SPECIAL SHAPES IN SILICA

ORTH REINFORCED ROOF FOR OPEN HEARTH FURNACES

PATENTED

O-A
18″ long
for 12-inch roof

O-8
15″ long
for 9-inch roof

O-B
18″ long
for 12-inch roof

O-9
15″ long
for 9-inch roof

O-C
18″ long
for 12-inch roof

O-10
15″ long
for 9-inch roof

ORZ
Repair Brick
for either 9-inch
or 12-inch roof

CHROME BRICK

CHROME brick are very refractory, dense in structure, and neutral. They are practically infusible.

In BASIC OPEN HEARTH STEEL FURNACE construction they are used as a neutral course between the fire clay brick on the bottom plates and the magnesia brick forming the foundation for the hearth or furnace bottom; also as a neutral course between the silica brick of the side walls and the magnesia brick of the bottom. The floors of ports and the facing of port walls and backwalls of uptakes are built of chrome brick in many furnaces.

In bottoms of SOAKING PITS six or eight courses of chrome brick replace fire clay brick with advantage.

Chrome brick are being used with good results along the slag line of COAL-FIRED HEATING FURNACES having cinder bottoms.

In COPPER SMELTING and REFINING PLANTS chrome brick are used in the bottom courses and around the tapping holes of BLAST FURNACES; in lining SETTLERS, especially on the slag matte line and around the tapping holes, and in lining CONVERTERS next to the shell. When chrome brick are put next to the shell they should be laid in furnace magnesite instead of special furnace chrome, the former sticking well to ironwork.

LEAD SOFTENING and REFINING FURNACES and many types of SPECIAL FURNACES used in melting and smelting alloys, have adopted chrome brick in places where fire clay or other refractory brick are rapidly destroyed.

Chrome brick should be laid in special furnace chrome with the exception noted above. They expand slightly at high temperatures. They should not be subjected to excessive weight when hot.

CHROME

STANDARD 9-INCH SIZES CARRIED IN STOCK

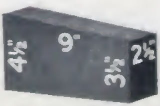
OTHER SHAPES WILL BE MADE TO ORDER

STRAIGHT
H.-W. R. Co.
9 x 4½ x 2½"

No. 1 WEDGE
88 Brick to the Circle
4′ 6″ Inside Diameter
H.-W. R. Co.
9 x 4½ x 2½ x 1⅞"

No. 2 WEDGE
55 Brick to the Circle
2′ 2″ Inside Diameter
H.-W. R. Co.
9 x 4½ x 2½ x 1½"

No. 1 KEY
113 Brick to the Circle
12′ Inside Diameter
H.-W. R. Co.
9 x 4½ x 4 x 2½"



No. 2 KEY
57 Brick to the Circle
5′ 3″ Inside Diameter
H.-W. R. Co.
9 x 4½ x 3½ x 2½"

MAGNESIA BRICK

WE use the highest quality selected magnesite in making Magnesia Brick. The utmost attention, care and experience are given to all the processes of manufacture and burning, and our Magnesia Brick are the standard of quality.

In BASIC OPEN HEARTH STEEL FURNACES a number of courses of magnesia brick are used in making the foundation for the bottom; the bottom being made of dead-burned magnesite. Side walls are built of magnesia brick to a height of about 15 inches above the bottom of the charging doors. They are used around the door jambs and tapping holes, and to face the furnace blocks as a protection to the silica brick. They are also being used to advantage in the bulkheads and the ports. Several companies report excellent results by putting in six or eight courses of magnesia brick as the top courses in the gas checkers.

In the construction of SOAKING PITS magnesia brick have replaced fire brick in the six or eight bottom courses, where they last a long time.

Magnesia brick are used along the slag line of METAL MIXERS instead of fire-clay brick.

In BILLET and BAR HEATING FURNACES running on producer or natural gas, magnesia brick are found to be an economy when used in the bottom and on the bridge wall. Sometimes bottoms are made of magnesite mixed with roll scale in the proportion of one ton of dead-burned magnesite to 600 or 800 pounds of roll scale.

Magnesia brick are being widely adopted by COPPER REVERBERATORIES; they are being used in the bottom, which is built as an inverted arch, and in the side walls and on the bridge wall to take the splash of the metal.

Their use in Copper Converters is too well known to require comment.

Special types of furnaces, such as SILVER SLIMES, DROSS and BULLION FURNACES, ELECTRICAL SMELTING, HEATING, WELDING and MELTING FURNACES; CALCIUM CARBIDE KILNS, etc., find the use of magnesia brick a solution of the problem of refractory linings.

Magnesia brick should be laid in furnace magnesite. They are very good conductors of heat, and where this heat conductivity would injure the plate work they should be backed up with some other of our high-grade material. They expand slightly at high temperatures. They are better conductors of electricity than porcelain at 2,000 degrees Fahrenheit or over; at low temperature their electrical conductivity is less than porcelain.

The best results are obtained from magnesia brick in furnaces where continuous heats are used. Great variation of temperature, exposure while hot to currents of cold air or to contact while hot with water or oil, will cause them to shatter and spawl.

Magnesia brick should not be subjected to excessive weight when hot.

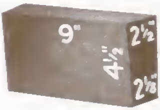
MAGNESIA

STANDARD 9-INCH SIZES CARRIED IN STOCK

OTHER SHAPES WILL BE MADE TO ORDER

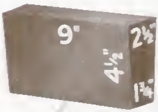
9-INCH STRAIGHT

9 x 4½ x 2½"



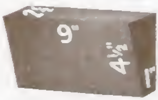
No. 1 ARCH

9 x 4½ x 2½ x 2⅛"



No. 2 ARCH

9 x 4½ x 2½ x 1¾"



No. 3 ARCH

9 x 4½ x 2½ x 1"

No. 1 WEDGE

9 x 4½ x 2½ x 1⅞"

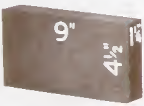
No. 2 WEDGE

9 x 4½ x 2½ x 1½"

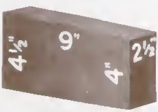
See Tables Pages 125 and 127

MAGNESIA
STANDARD 9-INCH SIZES CARRIED IN STOCK
OTHER SHAPES WILL BE MADE TO ORDER

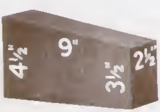
SOAP
9 x 2¼ x 2½"



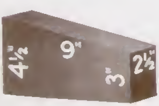
SPLIT
9 x 4½ x 1¼"



No. 1 KEY
9 x 4½ x 4 x 2½"



No. 2 KEY
9 x 4½ x 3½ x 2½"



No. 3 KEY
9 x 4½ x 3 x 2½"

No. 4 KEY
9 x 4½ x 2¼ x 2½"

See Table Page 128

MAGNESIA CONVERTER SHAPES

SHAPE A

SHAPE B

SHAPE C

SHAPE D

For lining 12-foot Upright Converter shown on page 97, it requires the following:

1670 pieces shape A	80 pieces No. 2 Arch
575 pieces shape B	75 pieces Soaps
120 pieces shape C	30 pieces Split Brick
155 pieces shape D	1190 pieces No. 1 Keys

420 pieces Key Wedge
210 pieces 9-inch Straights
4 net tons Furnace Magnesite
6 net tons Dead Burned Magnesite
1½ net tons Silicate of Soda

DEAD-BURNED OR GRAIN MAGNESITE

THE first magnesite brought to the United States was a shipment of 800 tons, bought in Europe in 1885. The first basic steel made in the United States was manufactured in 1886. The use of magnesite has increased progressively with the increased production of basic steel.

Our magnesite is the standard quality and is prepared in the most careful manner, material shipped being carefully manufactured and selected. Owing to the severe rejections in the quarry and the shrinkage in weight in calcining, it is necessary to quarry five tons of rock for every ton of magnesite shipped. That which is accepted is hand-picked, absolutely dead-burned, and contains the correct proportion of fluxing constituents to make it frit or set at the proper temperature in the bottoms of BASIC OPEN HEARTH STEEL FURNACES. Its low silica and lime contents, careful selection, thorough burning and careful hand-picking make it the most uniform, satisfactory and economical, and in every way the best magnesite on the market.

The principal use of magnesite is for forming bottoms in BASIC OPEN HEARTH STEEL FURNACES. A more limited use of magnesite is to make bottoms in MECHANICAL PUDDLING FURNACES, HEATING FURNACES, and tamped in the side walls of COPPER REVERBERATORIES to take the splash of the metal.

CHROME ORE

SESQUIOXIDE of Chromium, known commercially as Chrome Ore, is exceedingly refractory, dense and neutral; it is neither acid, basic, reducing nor oxidizing.

It is used principally in BASIC OPEN HEARTH FURNACES, in such places as along the back walls of STATIONARY and TILTING FURNACES; on the floors of the ports, and as a protection to the silica brick in the ports and furnace blocks. Chrome Ore is generally useful where chemical action and high temperature combined are to be resisted.

We can furnish a Chrome Ore running especially low in silica and containing from 38 to 42 per cent. of chromium sesquioxide, and a Chrome Ore running 50 per cent. chromium sesquioxide or over, shipping either in lump form or finely ground, as ordered.

BLAST FURNACE LININGS

WE have been making blast furnace linings for more than forty years, and have made a large percentage of all the linings used in the United States. Our linings have been used under every imaginable condition, under hundreds of different managers, in all types of furnaces, and with all classes of ore and fuel.

In addition to furnishing hundreds of linings for large modern furnaces running on Lake ores and Connellsville coke, many linings have been supplied to smaller furnaces burdened with magnetite, limonite, brown, zincy, Cornwall, manganese and zinc residuum ores; and fuels such as high sulphur coke, anthracite and charcoal, which create conditions very severe on furnace linings.

We have been as successful in meeting the peculiar conditions under which many of these furnaces are operated as in the large modern furnaces in the Pittsburgh district running entirely on Basic and Bessemer iron.

In addition to the name of the brand, all of our blast furnace brick are now branded "HEARTH & BOSH," "INWALL" or "TOP." This is done to make it certain that the brick will be put into that part of the furnace for which they were made.

In order to get uniformly satisfactory results from a furnace, it is of great importance that the brick used for lining downcomers and flues be able to resist the cutting action of strong blasts charged with ore dust and cutting particles of coke. Our Pipe brands are made especially for this purpose and give good results.

Modern blast furnace practice, with closed tops, skip hoist, revolving tops and high-pressure blast, makes it more essential than ever before to use only the best blast furnace brick that can be manufactured. For years this branch of our business has received special attention, with the result that the records on tonnage made with our linings are, we believe, unapproached. Some of these records are shown on page 54.

The cut on page 57 shows 9-inch and 13½-inch brick as laid in a furnace wall. Cuts of shapes most generally used in blast furnace linings are shown on page 13.

BOTTOM BLOCKS

THE cuts on page 58 show the bottom blocks used at the present time. All blocks are rectangular, true to shape and form, close in bond, and made under heavy pressure.

All brands made of Pennsylvania clays are 18 x 12 x 8 inches. The Portsmouth Kentucky Dept. brands are 18 x 9 x 4½ inches.

BLAST FURNACE RECORDS

THE last 100 furnaces which have gone out of blast on our linings, and where we have been able to obtain both the length of the runs and tonnages, show an average life of 4 years, 6 months and 13 days. The same furnaces show an average tonnage of 651,444 tons per lining.

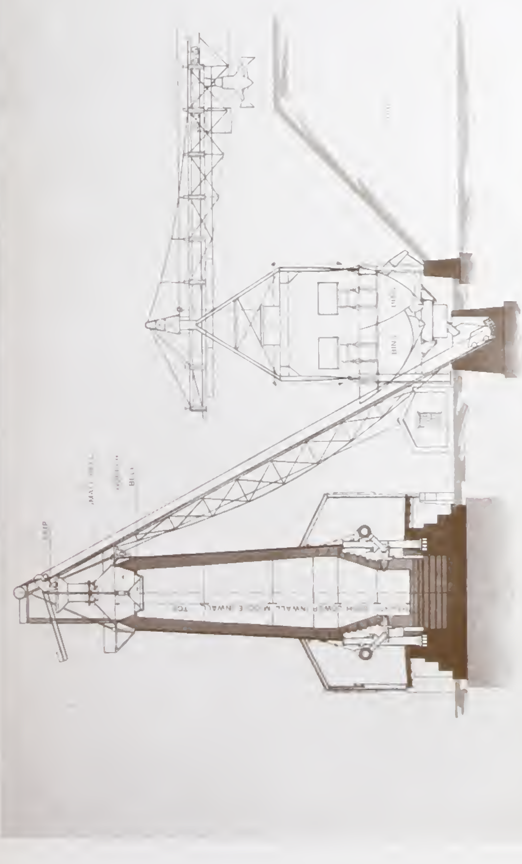
These furnaces varied in size from the small charcoal furnaces up to the largest modern furnaces. They were run on widely varying burdens. The ores used varied according to the location of the furnaces, and as a number of these furnaces were located in the east, the use of such ores as the Clinton, Cuban, Magnetites, Titaniferous, Zincy Ores, concentrates and nodules could not but help to materially effect the life and tonnages of many of the linings upon which this average was based.

SOME RECENT RECORD AND GOOD RUNS

District	Size of Furnace	Tonnage	Period in Blast
Pittsburgh	85′ x 21′	1,354,445	8 Yrs. 8½ Mos.
Valleys	85′ x 21′	1,053,673	7 " 8 "
Valleys	106′ 6″ x 23′	836,000	4 " 7 "
Pittsburgh	91′ x 22′	860,000	9 " 0 "
Pittsburgh	99′ x 22′ 1″	1,090,038	6 " 8 "
Pittsburgh	85′ x 21′	731,450	9 " 1 "
Pittsburgh	100′ x 22′	1,259,006	7 " 1 "
†Pittsburgh	100′ x 23′	†2,566,486	†14 " 3 "
†Pittsburgh	100′ x 22′	†2,169,343	†13 " 1 "
Pittsburgh	85′ x 21′	840,000	6 " 6 "
Pittsburgh	100′ x 22′	931,026	5 " 0 "
Pittsburgh	100′ x 22′	1,309,783	8 " 7 "
Pittsburgh	100′ x 22′	1,323,000	10 " 1 "
Chicago	85′ x 18′ 6″	700,000	6 " 2 "
Eastern	100′ x 22′	447,928	3 " 11 "
Eastern	85′ 7″ x 20′ 6″	585,000	3 " 4 "
Canada	76′ x 18′	416,000	5 " 5 "
Chicago	76′ x 17′ 6″	500,000	5 " 6 "
Chicago	90′ x 22′	700,000	5 " 5 "
Canada	85′ x 20′	406,000	4 " 5 "
Valleys	97′ x 20′	837,967	5 " 4 "
Valleys	94′ 6″ x 21′	900,000	5 " 6 "
Valleys	94′ 6″ x 21′	850,000	7 " 1 "
*Valleys	106′ 6″ x 21′	446,218	3 " 0 "
Chicago	88′ x 21′ 6″	501,000	3 " 5 "
Alabama	86′ 5″ x 21′ 9″	506,000	3 " 5 "
Chicago	88′ x 21′ 6″	448,000	2 " 2 "
*Chicago	90′ x 22′	697,000	4 " 11 "
Chicago	90′ x 21′ 6″	720,000	4 " 0 "
Valleys	106′ 6″ x 23′	827,580	5 " 0 "
Pittsburgh	85′ x 20′	590,000	4 " 9 "

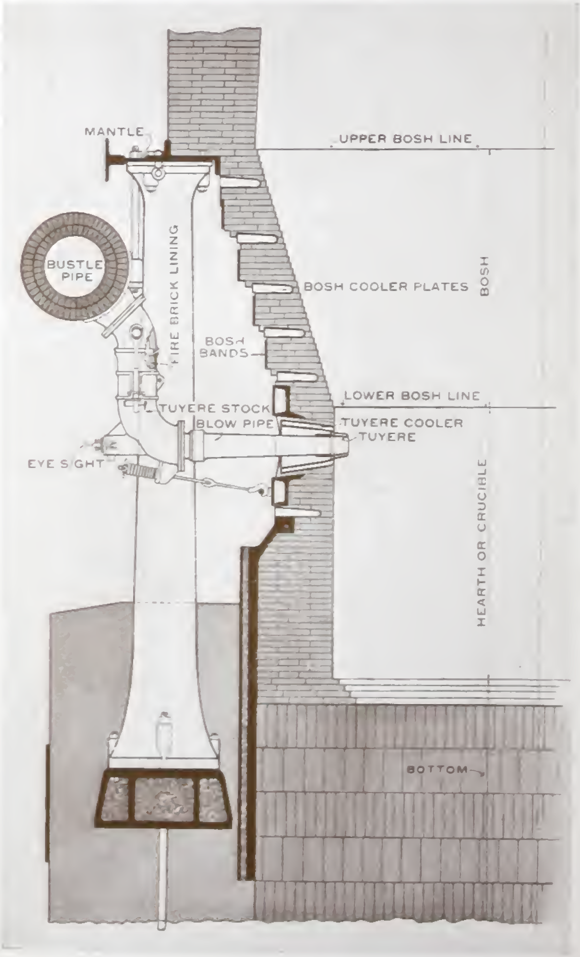
† Covers two consecutive runs. Figures on individual runs not available.

* Still running.



SECTION OF BLAST FURNACE SHOWING FILLING ARRANGEMENT, BINS AND ORE BRIDGE

SECTIONAL VIEW BLAST FURNACE HEARTH AND BOSH



MODERN BLAST FURNACE LINING

BLAST FURNACE BOTTOM BLOCKS

Above cuts show method of setting blocks and breaking joints in construction of furnace hearth.

See page 53 for description of blocks and page 136 for number required for different diameters.

BLAST FURNACE STOVE BRICK

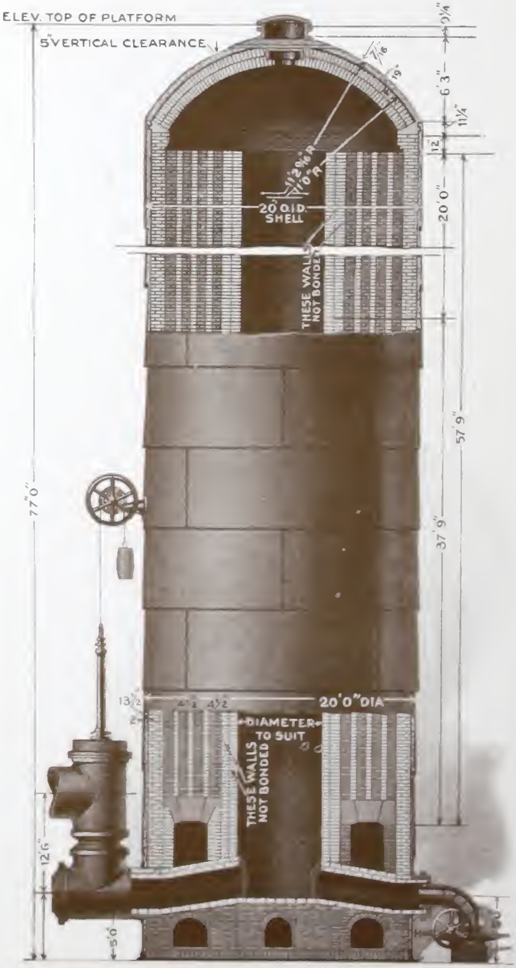
THE importance of blast furnace stove brick is only second to that of the furnace lining. Due to the disintegrating tendency of hot gases constantly varying in temperature and often carrying a considerable percentage of readily fusible dust, the problems encountered in making a brick which will withstand these conditions to the best advantage are as great as those involved in the manufacture of blast furnace linings.

The essential qualities in blast furnace stove brick are: capacity to absorb heat readily from the combustion of waste furnace gases, readiness to give off this heat rapidly to the air that is blown into the stove, and strength of bond between the particles of fire clay to resist the disintegrating action of the hot gases. These qualities can only be obtained by making the brick of high grade fire clay that will stand sufficient heat to bond thoroughly without vitrifying. In service, although stove brick are not subjected to the intense heat of the melting zone of the blast furnace, the weight carried and the long continued heat are apt to cause a gradual fusing, unless high grade clay with a liberal margin of refractoriness is used in making the brick.

If the brick becomes glazed or vitrified its efficiency is gone.

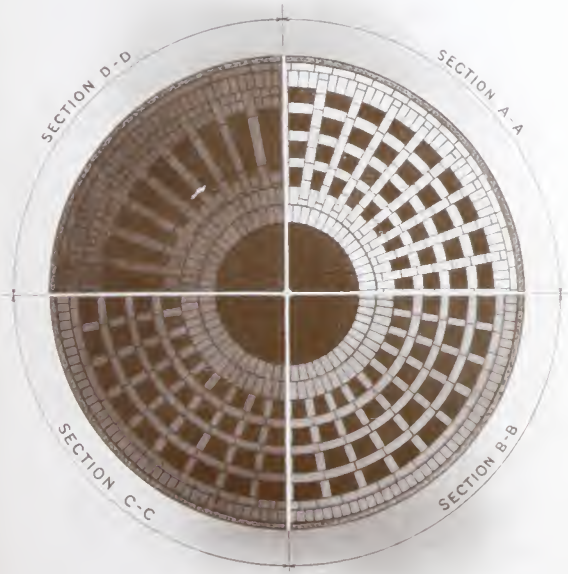
JULIAN KENNEDY STOVE

Julian Kennedy, Pittsburgh, Pa., Engineer



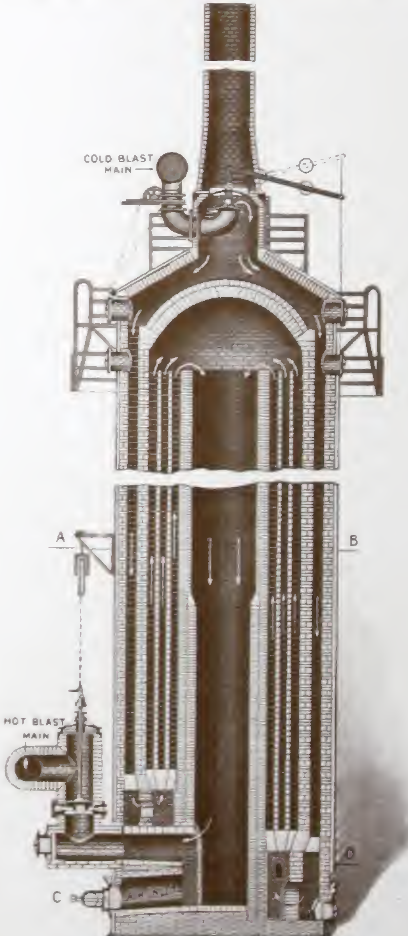
JULIAN KENNEDY STOVE

Julian Kennedy, Pittsburgh, Pa., Engineer



McCLURE PATENT STOVE

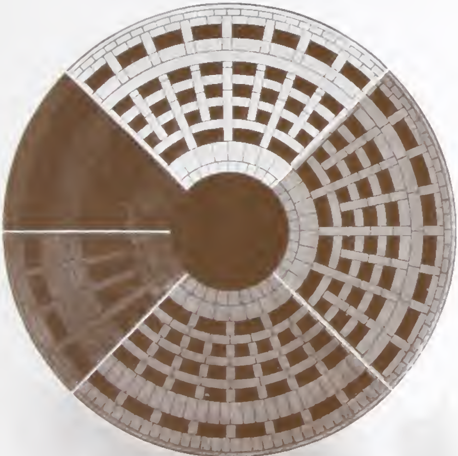
G. W. McClure, Son & Co., Pittsburgh, Pa., Engineers



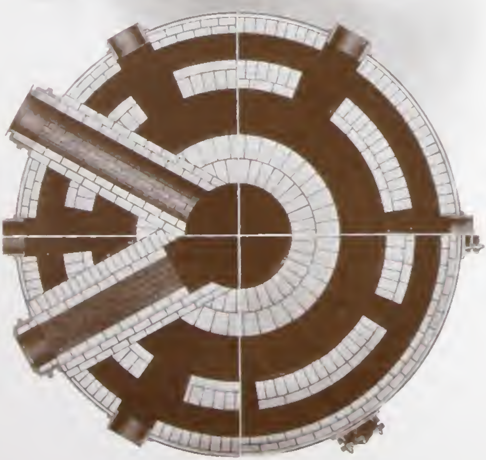
SECTIONAL ELEVATION

McCLURE PATENT STOVE

G. W. McClure, Son & Co., Pittsburgh, Pa., Engineers



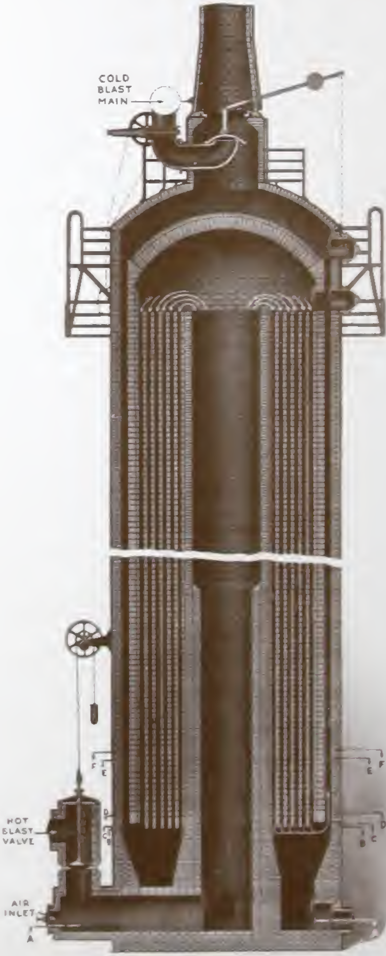
SECTION THROUGH A B



SECTION THROUGH C D

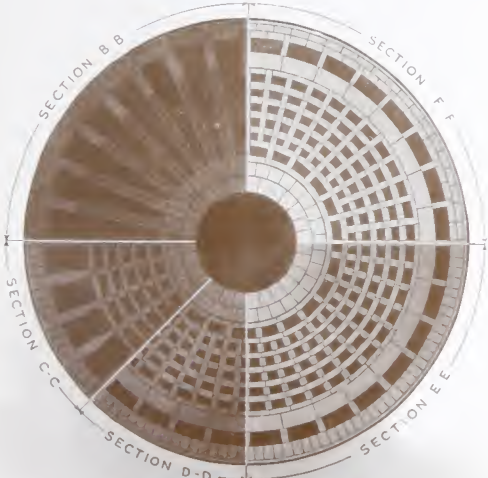
THE COULTAS THREE-PASS PATENT STOVE

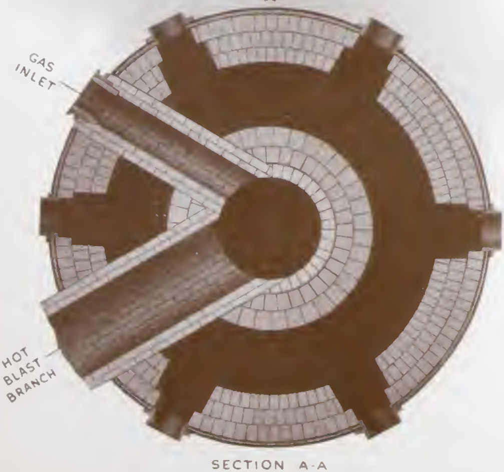
Searing & Coultas, Construction Engineers.
Pittsburgh, Pa.



THE COULTAS THREE-PASS PATENT STOVE

Searing & Coultas, Construction Engineers,
Pittsburgh, Pa.





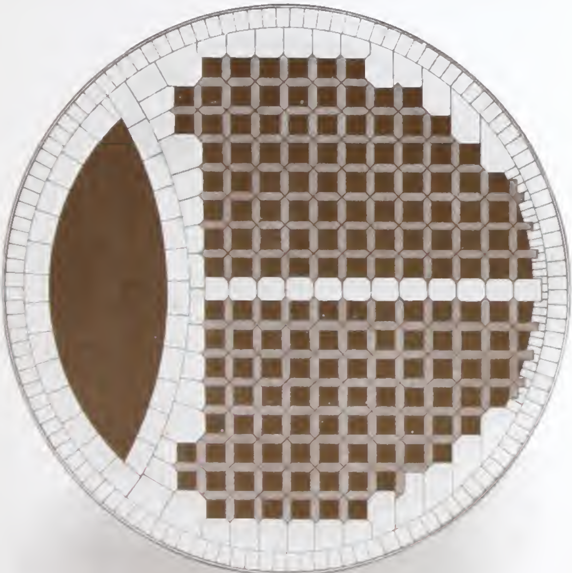
SECTION A-A

FOOTE PATENT STOVE

D. Lamond & Son, Ferguson Block, Pittsburgh, Pa., Engineers

FOOTE STOVE

D. Lamond & Son, Ferguson Block, Pittsburgh, Pa., Engineers

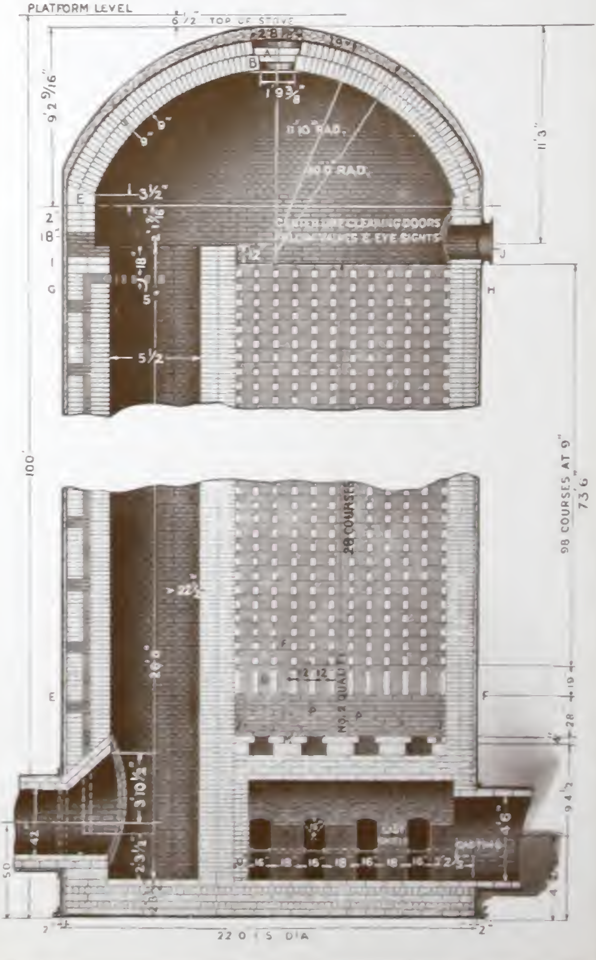


ENLARGED CROSS SECTION

CHECKER BRICK

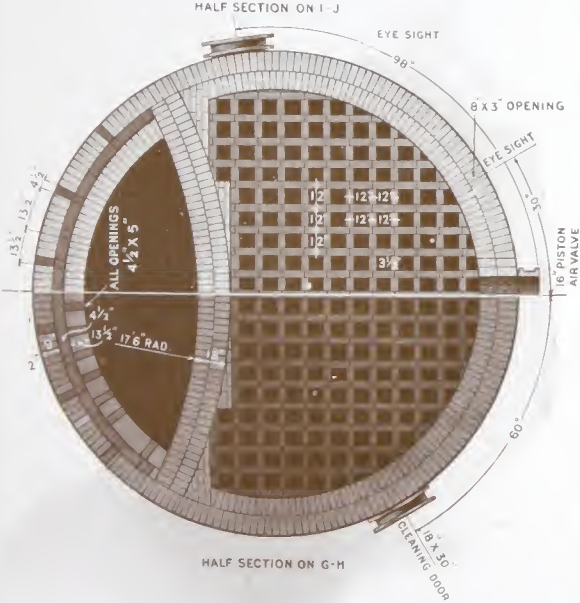
ROBERTS PATENT STOVE

F. C. Roberts & Co., Philadelphia, Pa., Engineers



ROBERTS PATENT STOVE

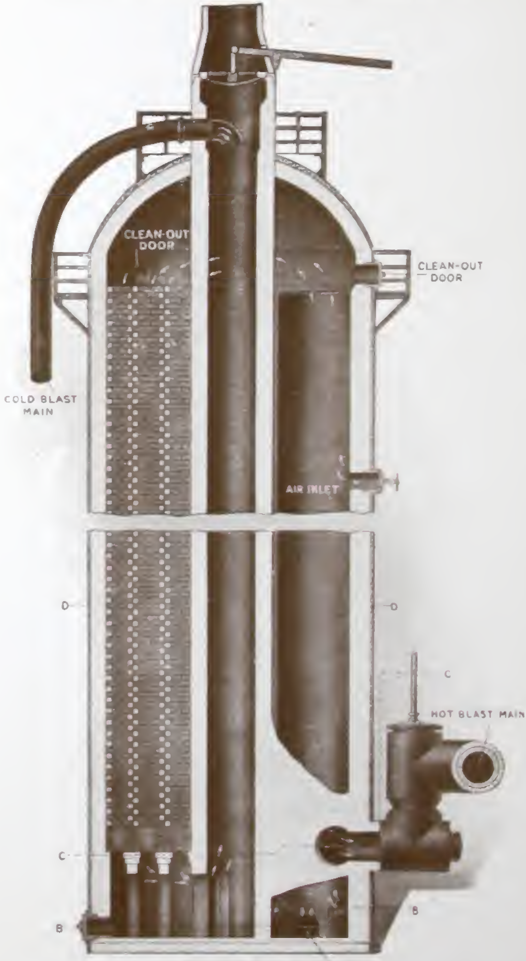
F. C. Roberts & Co., Philadelphia, Pa., Engineers



Checker Brick

CALDER HOT BLAST STOVE

The S. R. Smythe Co., Engineers, Pittsburgh, Pa.



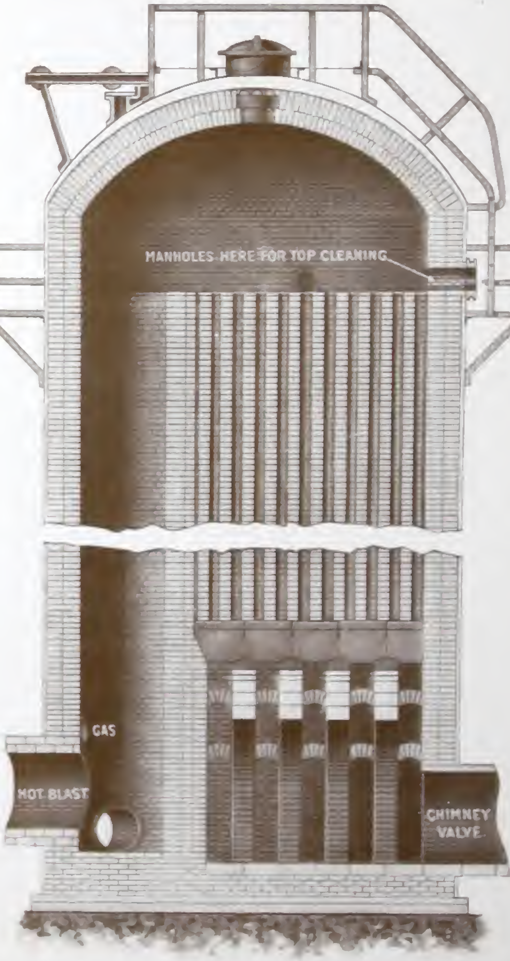
CALDER HOT BLAST STOVE

The S. R. Smythe Co., Engineers, Pittsburgh, Pa.

NOTE:
MADE OF 9" & 13½" BRICK

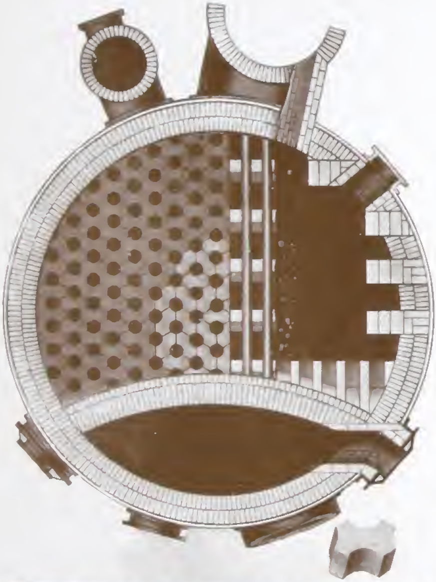
WHITE & KERNAN HOT BLAST STOVE

F. L. White. Patented Feb. 21, 1905, No. 783,234



WHITE & KERNAN HOT BLAST STOVE

F. L. White. Patented Feb. 21, 1905, No. 783,234

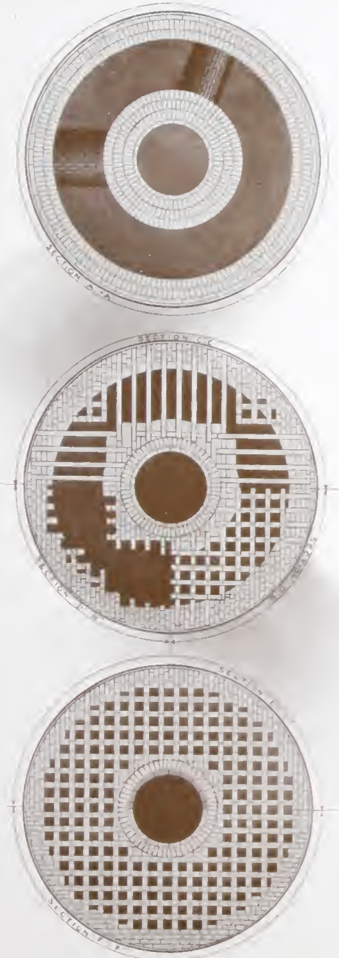


THE NELSON STOVE

Arthur G. McKee, Engineer, Cleveland, O.

THE NELSON STOVE

Arthur G. McKee, Engineer, Cleveland, O



Upon this one point, namely maintenance of thermal capacity, too much emphasis cannot be placed. Two brick may show up equally well in a heat test of short duration, yet the one after a few months of hard usage becomes vitrified and its thermal capacity lowered while the other is practically unaffected and will continue to give full service for years. It is safe to say that the day is coming when the factor of efficiency in stove refractories will be appreciated more nearly at its worth and the blast furnace manager will not permit himself to be handicapped by inefficient equipment.

The records on our stove linings indicate how successfully we have solved these problems.

In connection with illustrations of typical stoves in use, a cut of the special shape used in each of several types is shown; these, and all similar shapes for stoves, are made from the highest grade clay, and with exceptionally strong bond to resist the disintegrating action of the hot gases.

For cuts of stoves in general use, see pages 60 to 75, inclusive.

COKE OVEN BRICK

COKE oven construction has changed radically in recent years. Where formerly the use of inferior material may have been countenanced, of late the tendency has been to use the highest grade brick.

The excellent results obtained from the use of silica brick in the severe service of by-product ovens, and in the old beehive ovens in the Connellsville region and other districts, have clearly demonstrated that our silica brick are the most economical that can be used in this work, due entirely to the increased length of service obtained by their use.

Our "H-W Crown" lime bond silica brick are made for the crowns of beehive ovens, and in addition to their extreme refractory qualities are especially adapted to hold the crown rigid and true to shape through varying temperatures, making in all a more thorough construction physically than can be obtained by the use of clay brick.

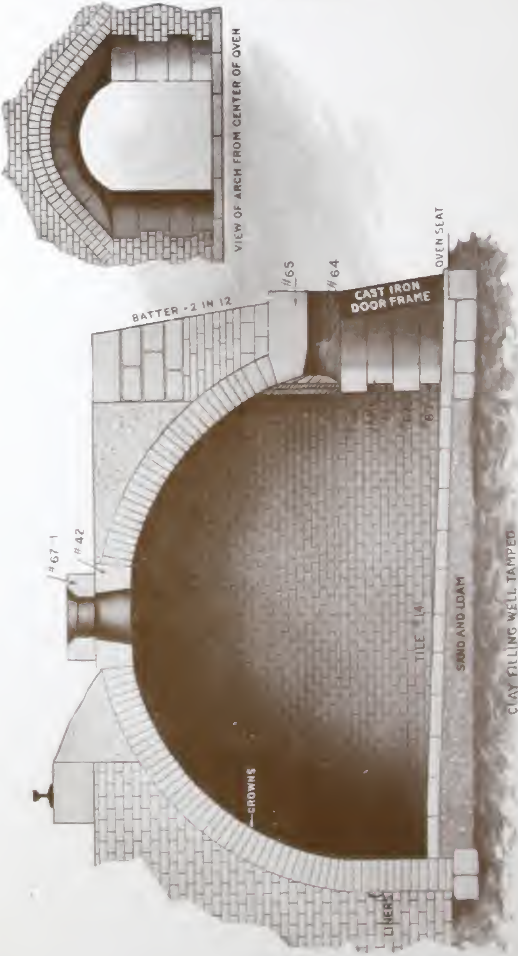
We also manufacture "XX Silica," a lime bond silica brick which is being widely used with the best of results in flues leading from beehive ovens to stacks and also to boilers where waste heat from the ovens is utilized.

The fronts are made of quartzite and the floor tile of fire clay. Trunnel heads are made of either silica or fire clay, as may be desired. We also manufacture special shapes for oven doors, such as The Mitchell-McCreary Door, Knopf Door, etc., Special Arches and Jambs for machine-drawn ovens, including straight Jambs for 42", 44", 46" door.

The Longitudinal type of coke oven has been coming into favor very rapidly. Having furnished much of the brick that has been made for ovens of this type, we have determined the refractories most suitable for such ovens. Quartzite Liner Blocks are displacing all 9-inch liners above the regular liner blocks in longitudinal ovens. See cut for standard coke oven on page 78. A type of longitudinal oven is shown on page 79.

See pages 82 to 91, inclusive, for description of by-product coke ovens.

STANDARD BEE HIVE COKE OVEN
HAND DRAWN 32" DOOR
CROSS SECTION



LONGITUDINAL OR BELGIAN OVEN

BY-PRODUCT COKE OVENS

COKE was first manufactured on a small scale in the United States about 1850, increasing slowly for a few years, then with great rapidity as the production of iron increased. At this date over 47,000,000 tons are manufactured annually, approximately 30 per cent. of which is made in BY-PRODUCT Ovens. Only BEE HIVE Oven Coke was made until about 1893. The striking increase in the production of BY-PRODUCT Coke is shown by comparing the production in 1897, when it was approximately 262,000 tons, and in 1906, when it was over 4,500,000 tons.

We have furnished a large percentage of the entire requirements of high grade refractories used in the construction of BY-PRODUCT Ovens in the United States and Canada.

When we first went into this business we conducted a long, expensive, and carefully planned series of experiments to determine the proper mixes and methods of manufacturing and burning the various shapes used in BY-PRODUCT Coke Oven construction, and possess at this time much detailed and specific information on the subject.

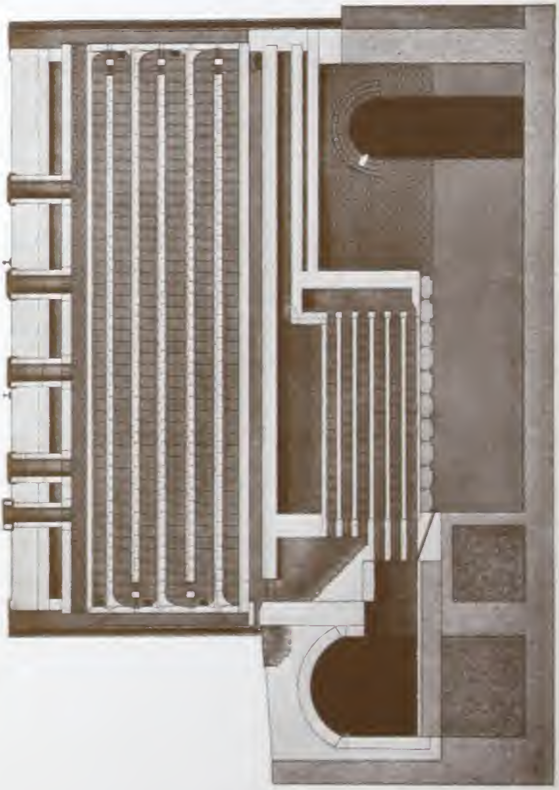
In the Plants first constructed a special Quartzite mix was used in the flues and other portions of the Oven where gas-tight joints

were required. In recent construction Silica Brick has supplanted Quartzite Brick, and we have no hesitation in recommending the use of Silica Brick as a material superior to Quartzite Brick for those portions of the Oven where Quartzite, either domestic or imported, was previously employed.

Silica Brick and shapes have a slight, uniform, known expansion and when built with the proper allowance for expansion joints, make an extremely durable Oven. Silica Brick are better conductors of heat than Fire Clay Brick. The use of Silica Brick in BY-PRODUCT construction increases the coking capacity of the Oven by decreasing the time required for coking the coal by reason of the greater conductivity of Silica Brick over Fire Clay or Quartzite Brick, and permitting a greater initial heat in the coking chamber.

Illustrations of the various BY-PRODUCT Ovens now in use in the United States are shown on the following pages.

SEMET-SOLVAY CO. TYPICAL SECTIONS OF COKE OVENS

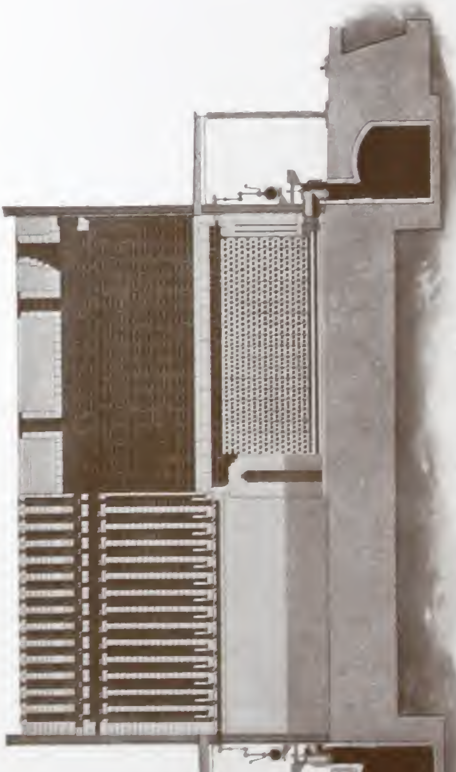


SEMET-SOLVAY CO.
TYPICAL SECTIONS OF COKE OVENS

VERTICAL CROSS SECTION

KOPPERS REGENERATIVE COKE OVEN

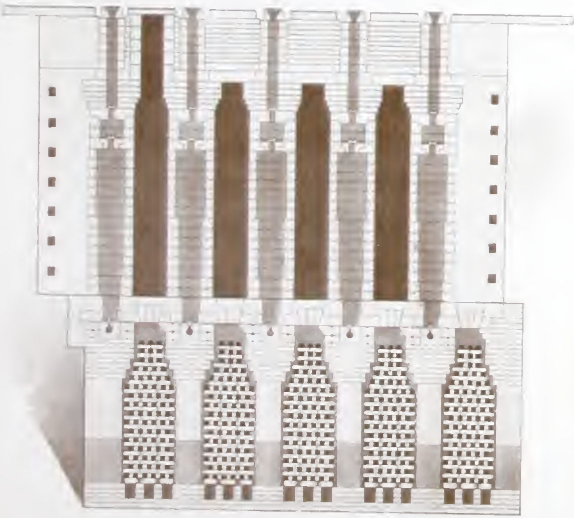
SEPARATE REGENERATORS FOR EACH OVEN



LONGITUDINAL SECTION THRU OVENS AND HEATING FLUES

KOPPERS REGENERATIVE COKE OVEN

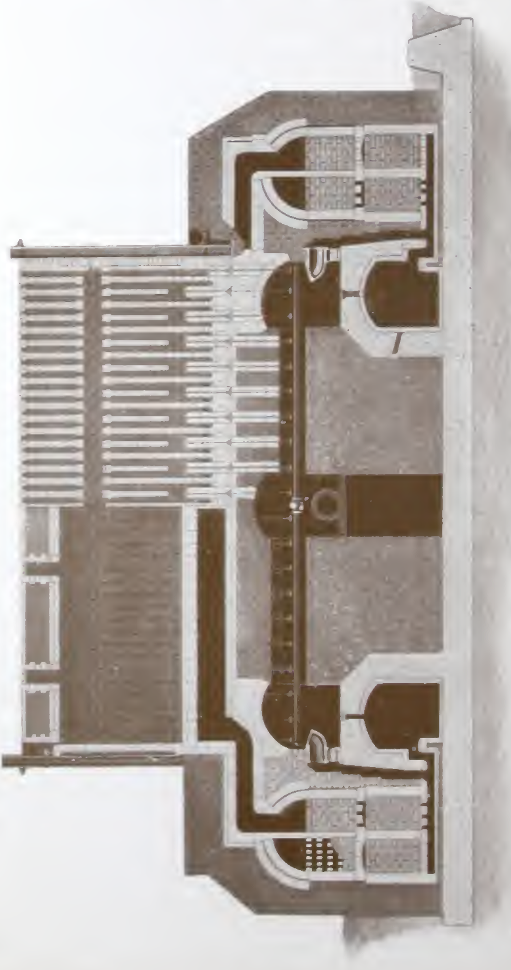
SEPARATE REGENERATORS FOR EACH OVEN



CROSS SECTION THRU OVENS

OTTO COKING CO. BY-PRODUCT COKE OVEN

Otto Coking Co., 6 Church St., New York City



OTTO COKING CO. BY-PRODUCT COKE OVEN

Otto Coking Co., 6 Church St., New York City

SECTIONAL PLAN THROUGH BURNER BRICKS AND AIR AND WASTE HEAT DUCTS

BY-PRODUCT COKE O

United Coke and Gas Com

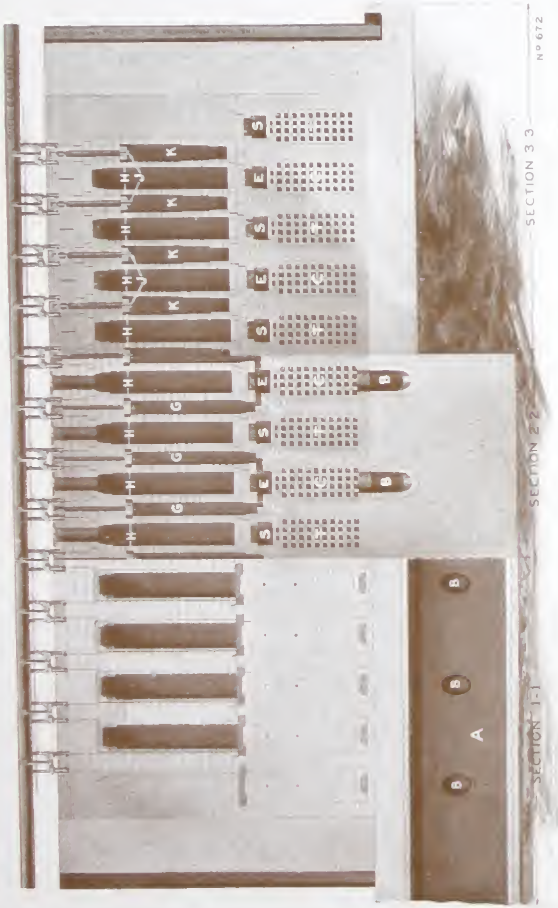
UNITED OTTO SYSTEM
d
17 Battery Place, New York

REGENERATIVE COKE OVEN

The Gas Machinery Company, Cleveland, O.

REGENERATIVE COKE OVEN

The Gas Machinery Company, Cleveland, O.



MALLEABLE FURNACES

THE question of fire brick is of the utmost importance to managers and owners of Malleable Furnace plants, as in no other type of furnace do brick have to be renewed so frequently, or are brick costs so high per ton of output.

We supply a large percentage of the high grade brick used in malleable furnace bungs, sidewalls and stacks. We have secured and maintained our position against all competitors by using carefully selected high grade clays, care and knowledge in the manufacture of brick, and thorough inspection and selection of the finished product.

We have customers who have bought from us for from fifteen to thirty-six years. Our "WOODLAND," "WIGTON STEEL," "CLEARFIELD," "MUNRO," "MALLEABLE" and "HIGH GRADE" brands are known and used wherever there are Malleable Furnaces.

The cut on page 93 shows one type of Malleable Furnace.

MALLEABLE FURNACE

COPPER REVERBERATORIES, CONVERTERS, ETC.

THE use of the highest grade refractory material in copper practice is proving an economy due to the much longer life obtained. "STAR SILICA" Brick should be used in the roofs of reverberatory furnaces and our best grade of fire brick in the side walls and bottoms.

There is an increasing use of Magnesia and Chrome brick along the side walls of such furnaces, erosion from the slag being greatly reduced by their use, (see side wall construction, page 96).

Chrome brick around the charging holes of reverberatories and in the roofs of refining furnaces better resist erosion where there is much splashing of the bath.

The records for basic lined converters are made on our Magnesia Brick.

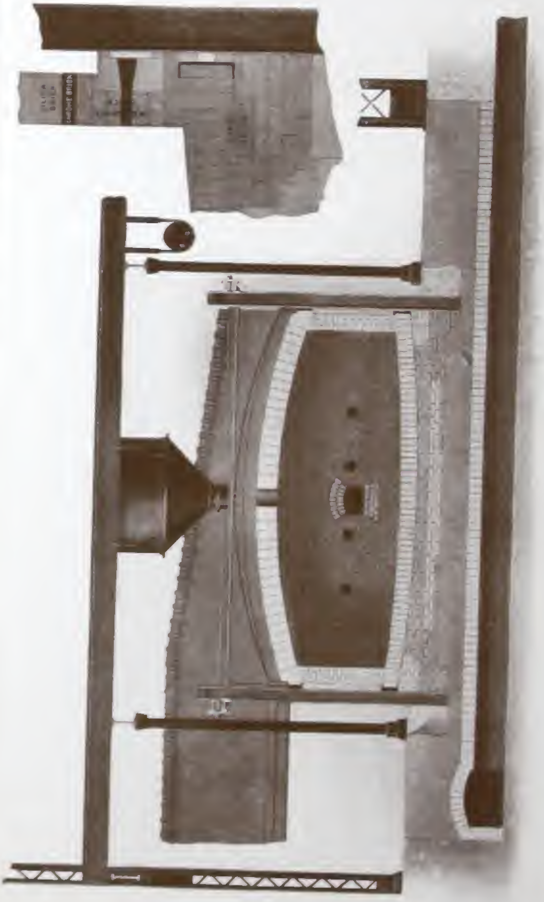
The superior workmanship of our brick means the best possible brick work and the lowest brick laying cost. The better joints secured increases the life of the furnace.

Cuts of Reverberatory, Converter and Refining Furnace shown on pages 95 to 98 inclusive.

REVERBERATORY FURNACE FOR COPPER SMELTING

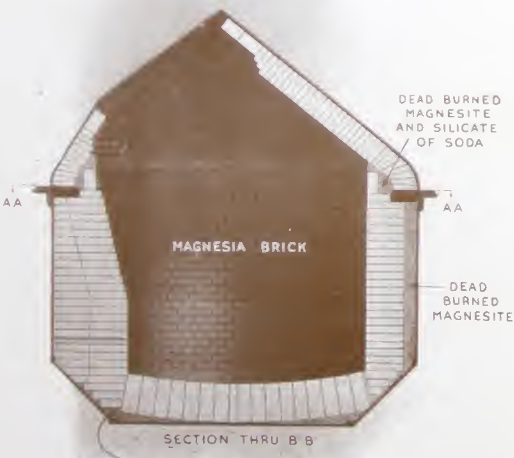
AN INCREASING NUMBER OF REVERBERATORY SMELTING AND REFINING FURNACES ARE USING MAGNESIA BRICK IN SIDE AND BRIDGE WALLS, AND PUTTING IN INVERTED BOTTOMS OF MAGNESIA BRICK.

REVERBERATORY AND CROSS SECTION SHOWING APPLICATION OF VARIOUS REFRACTORIES



12-FOOT UPRIGHT CONVERTER

PLAN A A



SECTION THRU B B

Shapes for Lining Shown on Page 50

METALLURGICAL FURNACE

L. Addicks and C. L. Brower. Patented January 16, 1914

BOILER SETTINGS

WE make a special feature of manufacturing brick for boiler settings.

The different types of boilers and the different fuels in use require varied properties in the brick used in different sections of the brickwork; in some cases the best brick to use depends entirely upon the heat-resisting quality; in others, upon resistance to the impinging action of flame and spawling; while in others, upon the ability to resist the action of clinker and poker, together with heat-resisting qualities.

The large units of the modern boiler, such as the Stirling, Babcock & Wilcox, Cahall, Heine, Wickes, Rust, Maxim and other types, require the best possible grade of brick in the setting, ESPECIALLY IN THE ARCH AND FIRE BOX.

In boiler setting, it is important that the workmanship and material be such that interruptions in the steam supply occur as seldom as possible.

Numerous changes have been made in boiler settings at our suggestion, particularly with regard to the kind of brick used at critical points. These changes were followed with marked improvement in the steam records of the boiler plants.

Whenever called upon to do so, we will have our engineering department get out blueprints and counts, showing the number and most suitable brick required for different sections of the furnace walls for any type of boiler.

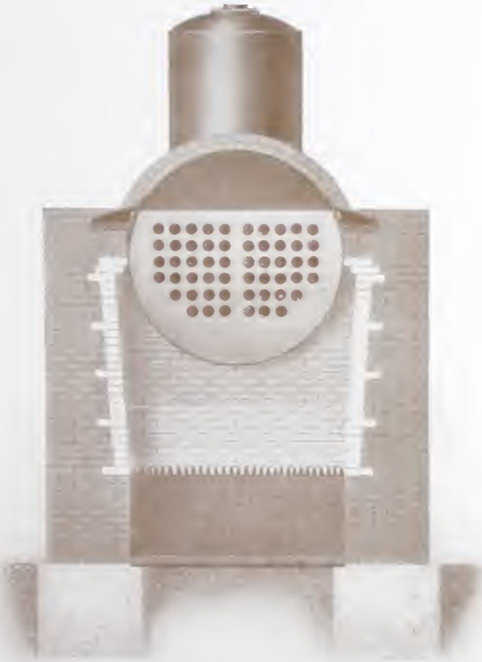
Different types of boiler settings are shown on pages 100 to 111 inclusive.

TYPICAL RETURN TUBULAR BOILER

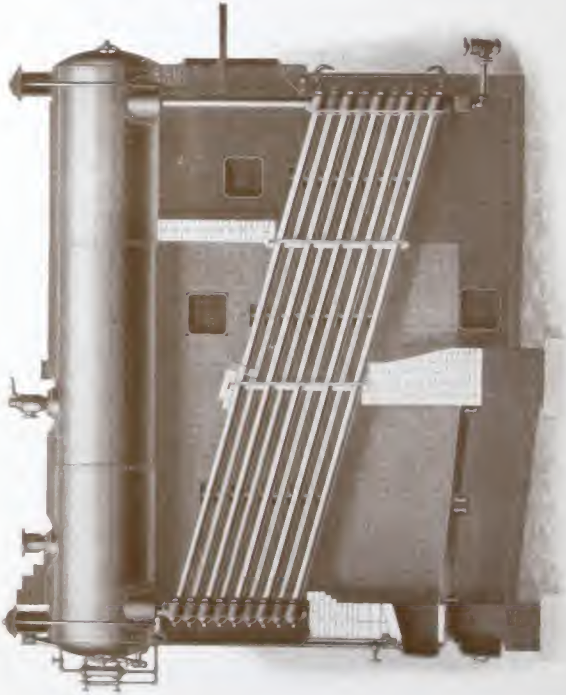
LONGITUDINAL SECTIONAL ELEVATION

TYPICAL RETURN TUBULAR BOILER

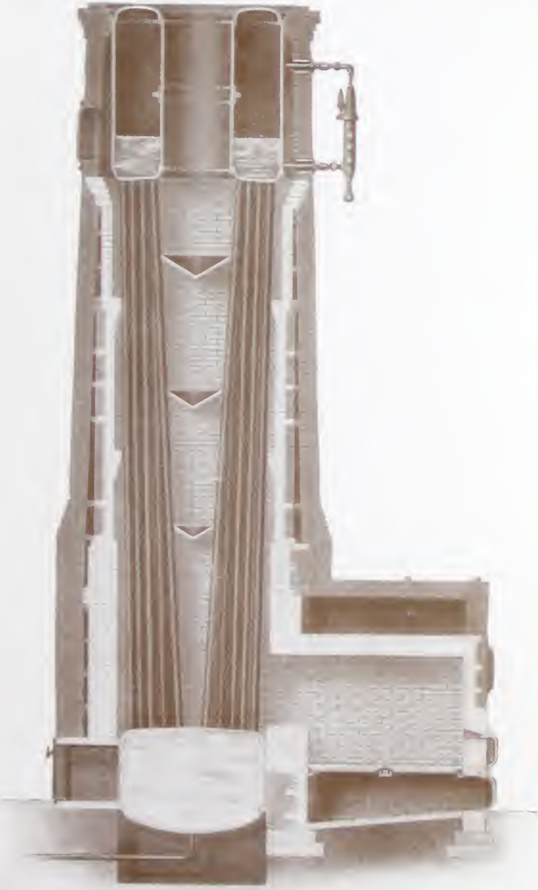
SECTION THROUGH FURNACE



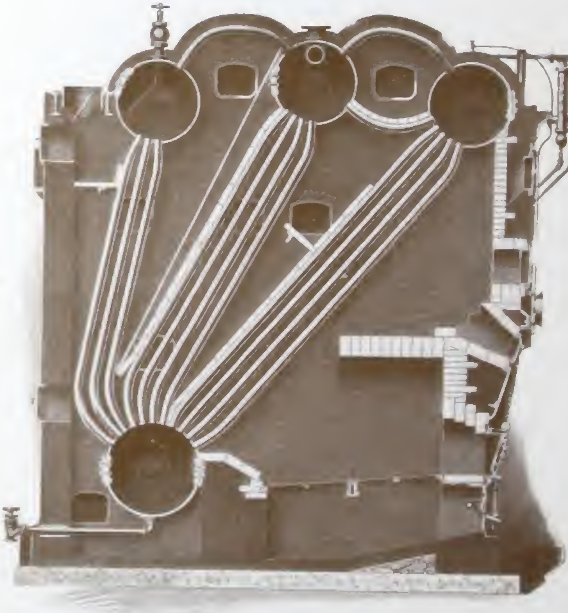
BABCOCK & WILCOX WATER TUBE BOILER



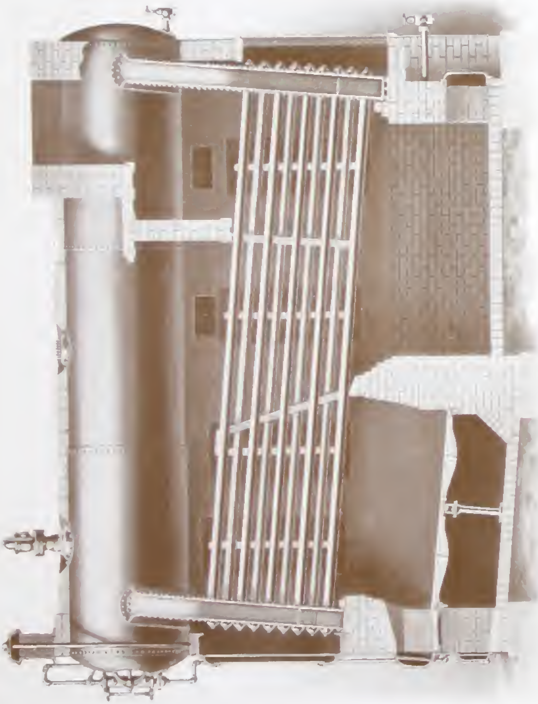
CAHALL VERTICAL WATER TUBE BOILER



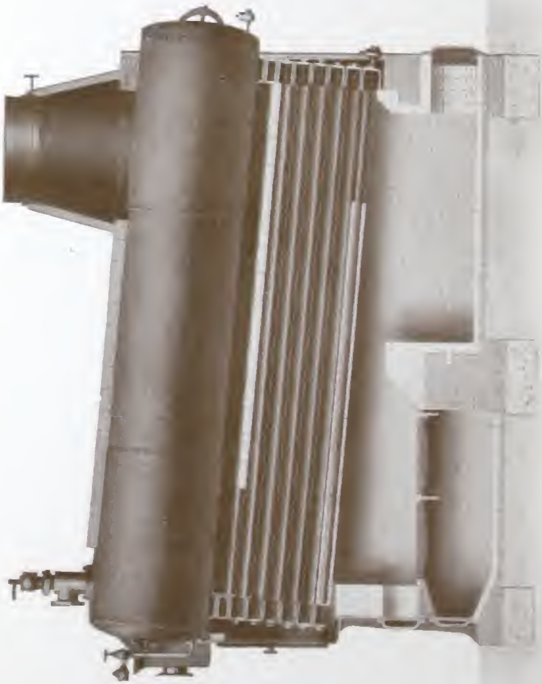
STIRLING WATER TUBE BOILER



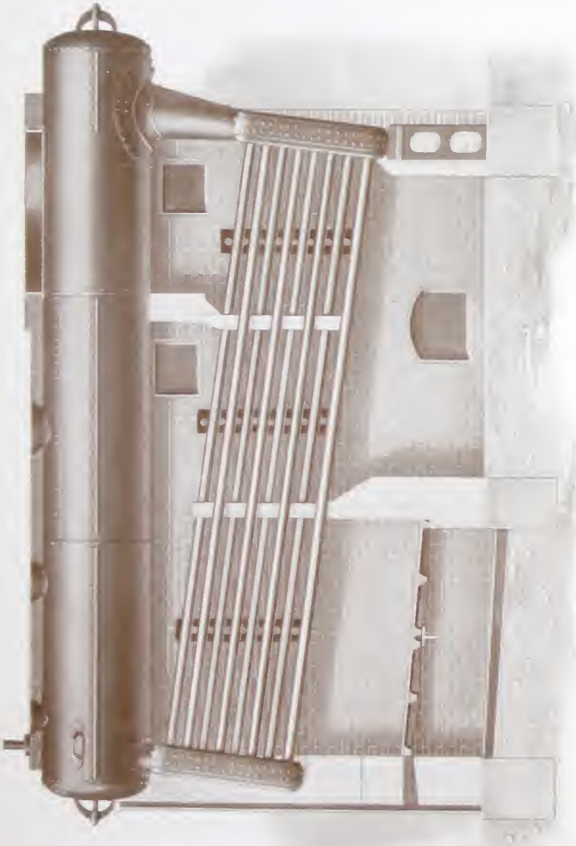
KEELER WATER TUBE BOILER



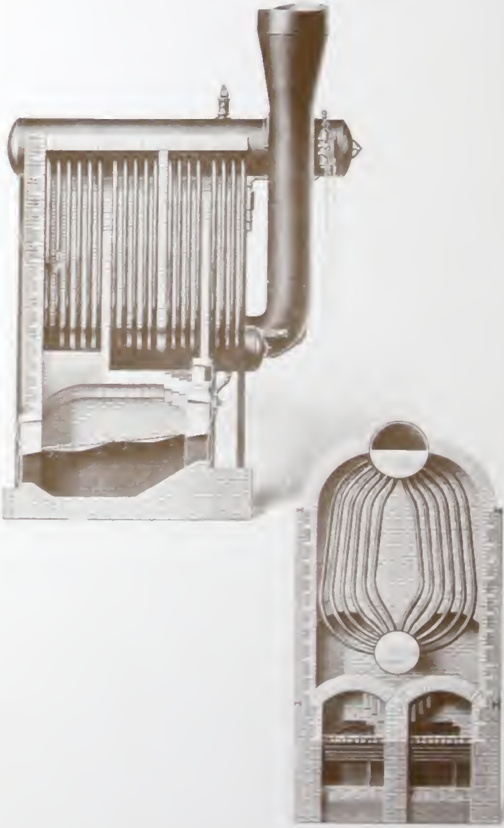
HEINE HORIZONTAL WATER TUBE BOILER



UNION IRON WORKS WATER TUBE BOILER

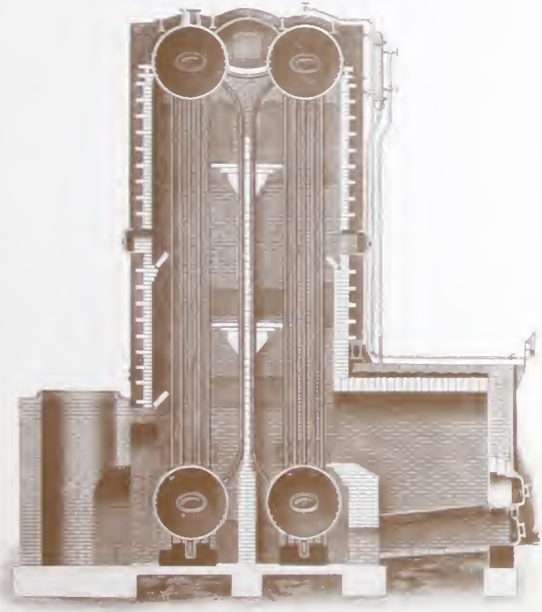


MAXIM WATER TUBE BOILER

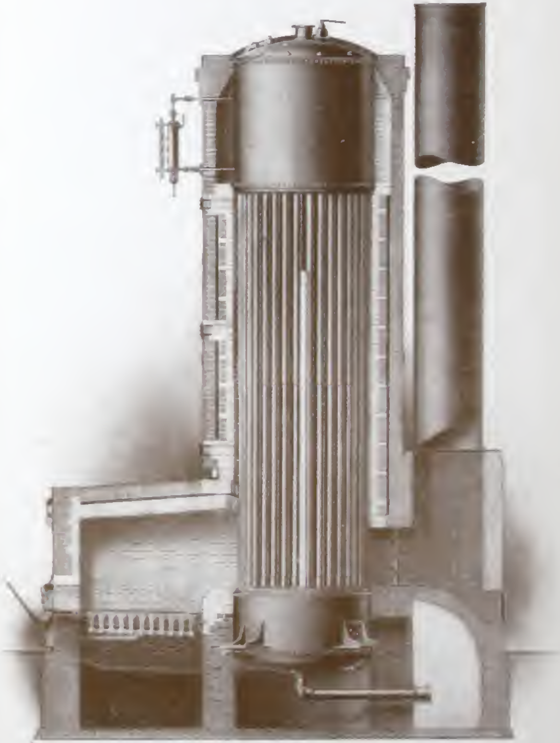


THE RUST WATER TUBE BOILER

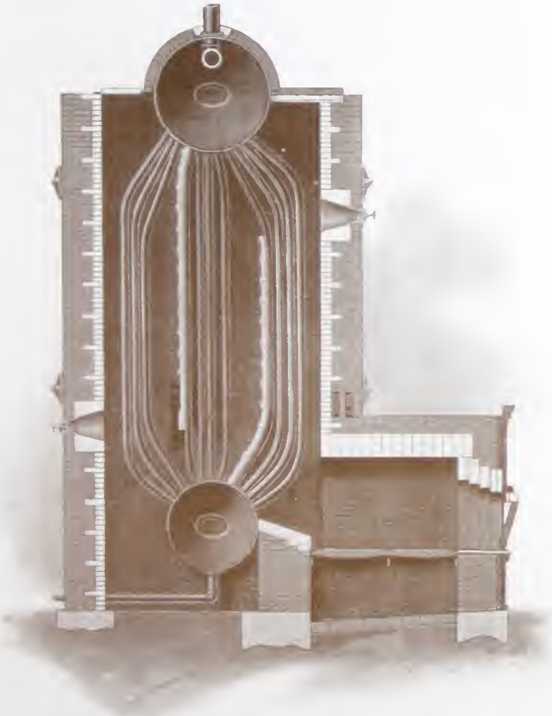
SECTION THROUGH BOILER



WICKES VERTICAL WATER TUBE SAFETY STEAM BOILER



ERIE CITY IRON WORKS VERTICAL WATER TUBE BOILER



COAL GAS BENCHES AND WATER GAS PLANTS

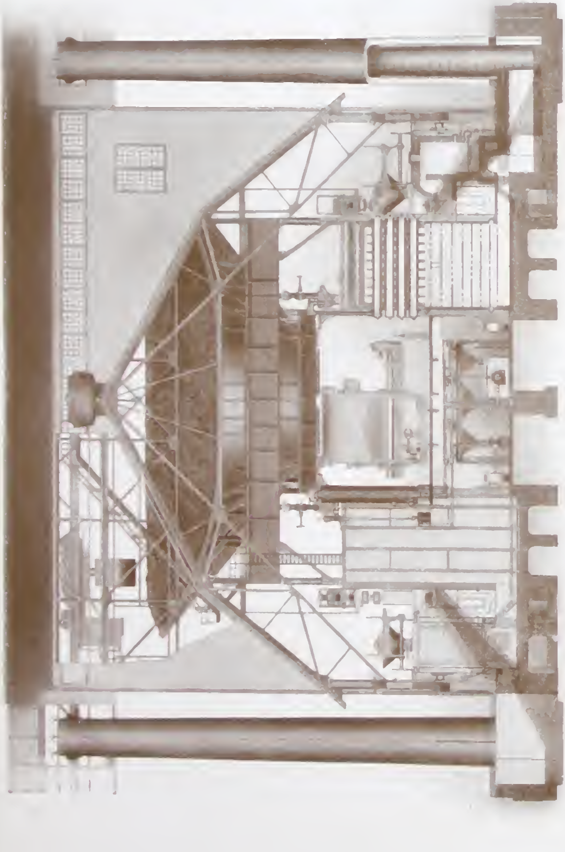
THE question of the quality of refractory materials is becoming one of increasing importance to managers of Gas Plants. In the past, the limit of endurance of refractory materials used has been the controlling factor in limiting the output per unit of capacity. We are now making Sectional Retorts and Setting Shapes of "H.-W. RICON" (our Special High Silica) which is so high in heat resisting qualities that the only limit to rapidity of operation is the heat at which the gas would disintegrate or decompose. This has effected a decrease in the time of carbonizing, thus increasing the number of charges in a given time and consequently showing an actual increase in production per retort of from 40 to 50 per cent. Sectional retorts have previously been unsatisfactory, due to shrinkage; "H.-W. RICON" expands with heat, making a durable retort which is permanently gas tight.

In addition to "H.-W. RICON," mentioned above, we also manufacture fire clay shapes for use in regenerators, fixers, carburetors and checkers. Our material has been found to be particularly suitable for all purposes in Coal Gas Benches and Regenerators and in Water Gas Plants.

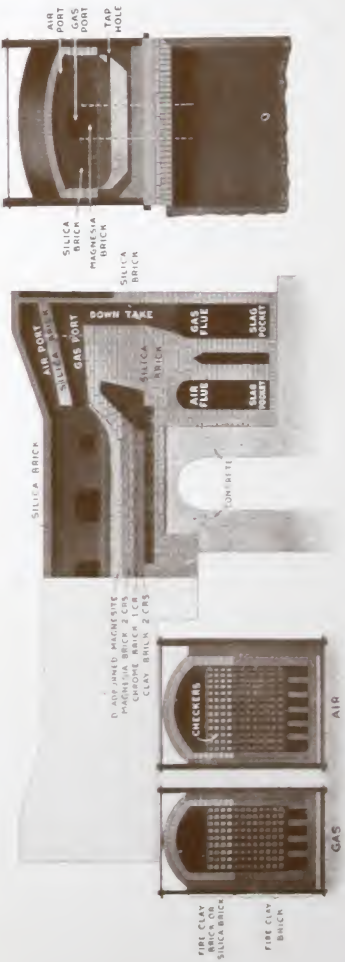
SECTION OF RETORT

STANDARD RETORT GAS HOUSE

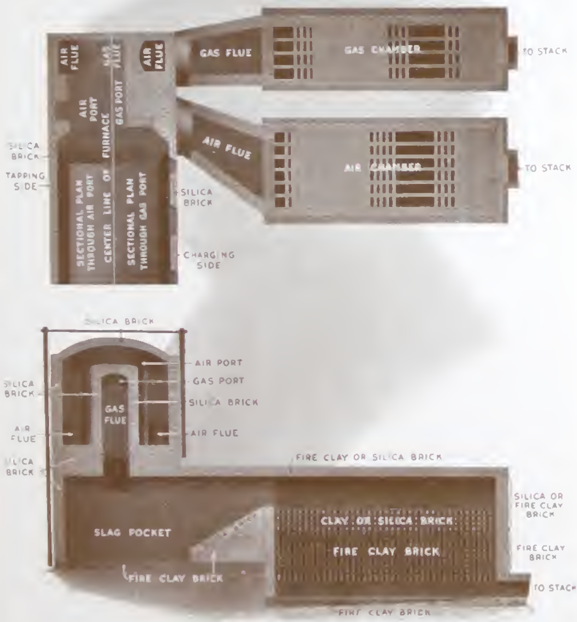
Riter-Conley Mfg. Co., Pittsburgh, Pa



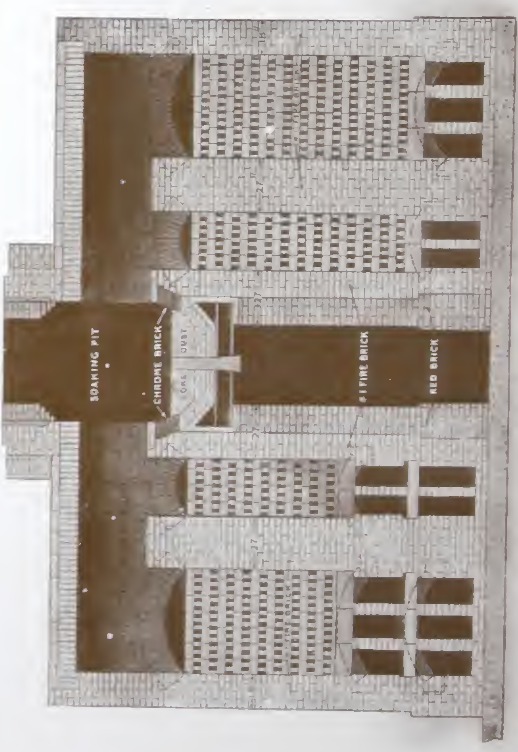
MODERN OPEN HEARTH FURNACE



MODERN OPEN HEARTH FURNACE



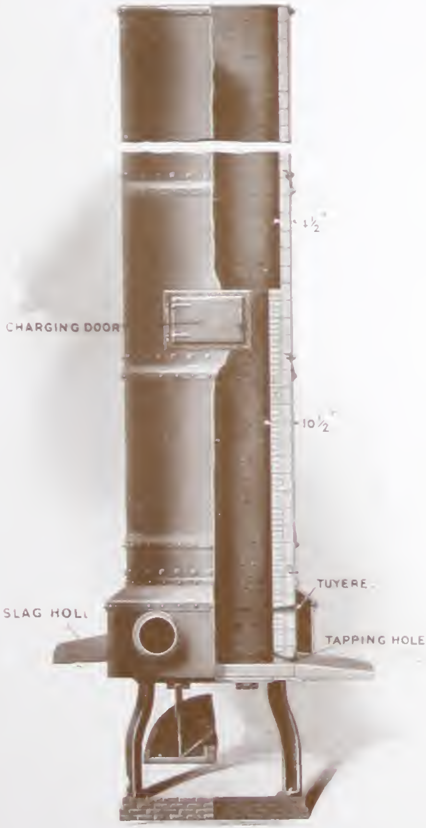
FOUR-HOLE SOAKING PIT FURNACE



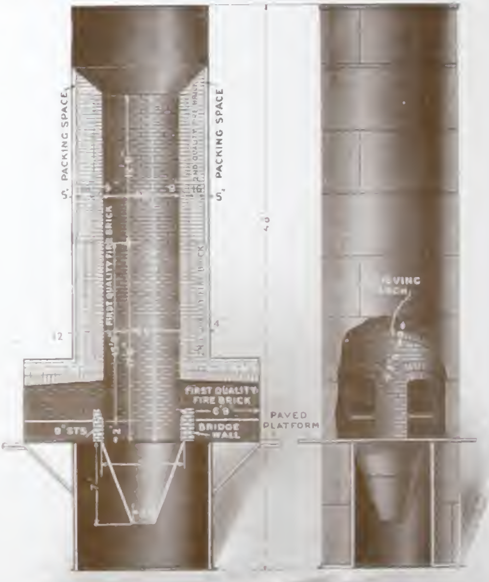
SKETCH OF SOAKING PIT SHOWING USE OF CHROME BRICK

CROSS SECTION OF TYPICAL PRODUCER GAS GLASS TANK

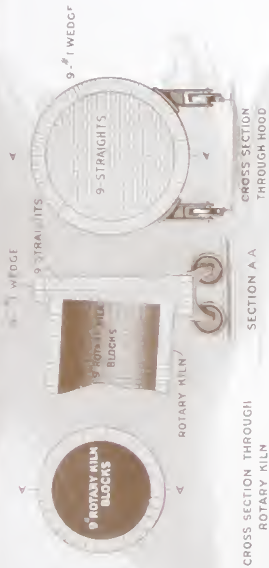
SECTION OF TYPICAL CUPOLA



TYPICAL LIME KILN

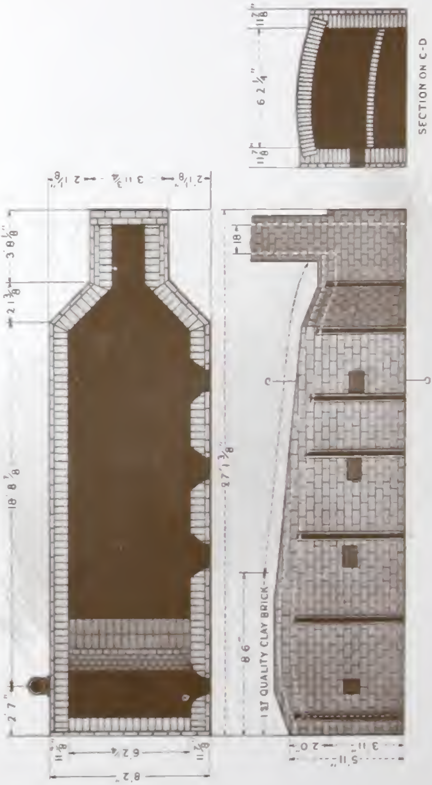


STANDARD ROTARY CEMENT KILN AND LINING



TYPICAL LINING FOR CEMENT KILN HOOD

TYPICAL COAL-FIRED HEATING FURNACE



TYPICAL GAS-FIRED HEATING FURNACE

GENERAL INFORMATION ABOUT FIRE BRICK

ALL FIRE BRICK SHOULD BE KEPT IN A DRY PLACE

Moisture, especially in cold weather, will greatly injure any brick.

To obtain the best results from brickwork, observe the following precautions:

Use good fire clay equal in refractoriness to the brick itself, mixing with water to thin soup. Dip brick and rub to make a brick to brick joint.

Warm slowly to expel moisture.

Bear in mind that fire clay brick contract, and silica, chrome and magnesia brick expand under high temperatures.

Sudden variations of temperature cause silica brick to spawl, and also reduce their refractoriness. All furnaces in which silica brick are used should therefore be heated up and cooled down slowly and uniformly.

From 250 to 350 pounds of fire clay or silica cement are enough to lay one thousand brick. Fine ground fire clay should be used for laying up fire clay brick, silica cement for silica brick, magnesia cement for magnesia brick, and chrome cement for chrome brick.

For estimating on fire brick work, use the following figures:

1 square foot 4½-inch wall requires 7 brick

1 square foot 9-inch wall requires 14 brick

1 square foot 13½-inch wall requires 21 brick

1 cubic foot brickwork requires 17 nine-inch straight brick

1 cubic foot fire clay brickwork weighs 150 pounds

1 cubic foot silica brickwork weighs 130 pounds

1,000 brick (closely stacked) occupy 56 cubic feet

1,000 brick (loosely stacked) occupy 72 cubic feet

For estimating on red brickwork, figure on nine cubic feet of sand and three bushels of lime for laying 1,000 brick.

TABLE OF WEDGE BRICK

Inside Diameter	No. 2 Wedge	No. 1 Wedge	Straight	Total
2 ft. 3 in.	57	....	....	57
2 " 6 "	49	11	....	60
3 " 0 "	38	30	....	68
3 " 6 "	26	50	....	76
4 " 0 "	12	71	....	83
4 " 6 "	....	91	....	91
5 " 0 "	....	91	8	99
5 " 6 "	....	91	15	106
6 " 0 "	....	91	23	114
6 " 6 "	....	91	30	121
7 " 0 "	....	91	38	129
7 " 6 "	....	91	45	136
8 " 0 "	....	91	53	144
8 " 6 "	....	91	60	151
9 " 0 "	....	91	68	159
9 " 6 "	....	91	76	167
10 " 0 "	....	91	83	174
10 " 6 "	....	91	91	182
11 " 0 "	....	91	98	189
11 " 6 "	....	91	106	197
12 " 0 "	....	91	113	204
12 " 6 "	....	91	121	212
13 " 0 "	....	91	128	219
13 " 6 "	....	91	136	227
14 " 0 "	....	91	143	234
14 " 6 "	....	91	151	242

TABLE OF WEDGE BRICK
CONTINUED

Inside Diameter	No. 2 Wedge	No. 1 Wedge	Straight	Total
15 ft. 0 in.	....	91	158	249
15 " 6 "	....	91	166	257
16 " 0 "	....	91	173	264
16 " 6 "	....	91	181	272
17 " 0 "	....	91	188	279
17 " 6 "	....	91	196	287
18 " 0 "	....	91	203	294
18 " 6 "	....	91	211	302
19 " 0 "	....	91	218	309
19 " 6 "	....	91	226	317
20 " 0 "	....	91	233	324
20 " 6 "	....	91	241	332
21 " 0 "	....	91	248	339
21 " 6 "	....	91	256	347
22 " 0 "	....	91	263	354
22 " 6 "	....	91	271	362
23 " 0 "	....	91	278	369
23 " 6 "	....	91	286	377
24 " 0 "	....	91	293	384
24 " 6 "	....	91	301	392
25 " 0 "	....	91	308	399
25 " 6 "	....	91	316	407
26 " 0 "	....	91	323	414
26 " 6 "	....	91	331	422
27 " 0 "	....	91	338	429
27 " 6 "	....	91	346	437

TABLE OF ARCH BRICK

Inside Diameter	No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	Total
0 ft. 6 in.	19	....	....	....	19
1 " 0 "	12	15	....	....	27
1 " 6 "	4	30	....	....	34
1 " 9 "	....	38	....	....	38
2 " 0 "	....	34	8	....	42
2 " 6 "	....	26	23	....	49
3 " 0 "	....	19	38	....	57
3 " 6 "	....	11	53	....	64
4 " 0 "	....	4	68	....	72
4 " 3 "	....	....	76	....	76
4 " 6 "	....	....	76	4	80
5 " 0 "	....	....	76	11	87
5 " 6 "	....	....	76	19	95
6 " 0 "	....	....	76	27	103
6 " 6 "	....	....	76	34	110
7 " 0 "	....	....	76	42	118
7 " 6 "	....	....	76	49	125
8 " 0 "	....	....	76	57	133
8 " 6 "	....	....	76	64	140
9 " 0 "	....	....	76	72	148
9 " 6 "	....	....	76	79	155
10 " 0 "	....	....	76	87	163
10 " 6 "	....	....	76	94	170
11 " 0 "	....	....	76	102	178
11 " 6 "	....	....	76	109	185
12 " 0 "	....	....	76	117	193

TABLE OF 9-INCH KEY BRICK

Inside Diameter	No. 4 Key	No. 3 Key	No. 2 Key	No. 1 Key	Total
1 ft. 6 in.	25	....	....	....	25
2 " 0 "	16	13	....	....	29
2 " 6 "	9	25	....	....	34
3 " 0 "	....	38	....	....	38
3 " 6 "	....	29	13	....	42
4 " 0 "	....	21	25	....	46
4 " 6 "	....	12	38	....	50
5 " 0 "	....	5	50	....	55
5 " 3 "	....	....	57	....	57
5 " 6 "	....	....	55	4	59
6 " 0 "	....	....	50	13	63
6 " 6 "	....	....	46	21	67
7 " 0 "	....	....	42	29	71
7 " 6 "	....	....	38	38	76
8 " 0 "	....	....	34	46	80
8 " 6 "	....	....	29	55	84
9 " 0 "	....	....	25	63	88
9 " 6 "	....	....	21	71	92
10 " 0 "	....	....	17	80	97
10 " 6 "	....	....	13	88	101
11 " 0 "	....	....	9	96	105
11 " 6 "	....	....	4	105	109
12 " 0 "	....	....	....	113	113

TABLE OF 9-INCH KEY BRICK
CONTINUED

Inside Diameter	No. 1 Key	Straight	Total
12 ft. 6 in.	113	4	117
13 " 0 "	113	9	122
13 " 6 "	113	13	126
14 " 0 "	113	17	130
14 " 6 "	113	21	134
15 " 0 "	113	25	138
15 " 6 "	113	30	143
16 " 0 "	113	34	147
16 " 6 "	113	38	151
17 " 0 "	113	42	155
17 " 6 "	113	46	159
18 " 0 "	113	50	163
18 " 6 "	113	55	168
19 " 0 "	113	59	172
19 " 6 "	113	63	176
20 " 0 "	113	67	180
20 " 6 "	113	71	184
21 " 0 "	113	76	189
21 " 6 "	113	80	193
22 " 0 "	113	84	197
22 " 6 "	113	88	201
23 " 0 "	113	92	205
23 " 6 "	113	97	210

TABLE OF 9-INCH KEY BRICK
CONTINUED

Inside Diameter	No. 1 Key	Straight	Total
24 ft. 0 in.	113	101	214
24 " 6 "	113	105	218
25 " 0 "	113	109	222
25 " 6 "	113	113	226
26 " 0 "	113	117	230
26 " 6 "	113	122	235
27 " 0 "	113	126	239
27 " 6 "	113	130	243
28 " 0 "	113	134	247
28 " 6 "	113	138	251
29 " 0 "	113	143	256
29 " 6 "	113	147	260
30 " 0 "	113	151	264
30 " 6 "	113	155	268
31 " 0 "	113	159	272
31 " 6 "	113	163	276
32 " 0 "	113	168	281
32 " 6 "	113	172	285
33 " 0 "	113	176	289
33 " 6 "	113	180	293
34 " 0 "	113	184	297
34 " 6 "	113	189	302
35 " 0 "	113	193	306

TABLE OF 13½-INCH KEY BRICK

Inside Diameter	No. 2 Key	No. 1 Key	Straight	Total
6 ft. 0 in.	52	....	....	52
6 " 6 "	48	7	....	55
7 " 0 "	42	16	....	58
7 " 6 "	37	24	....	61
8 " 0 "	33	32	....	65
8 " 6 "	28	40	....	68
9 " 0 "	23	48	....	71
9 " 6 "	18	56	....	74
10 " 0 "	12	65	....	77
10 " 6 "	7	73	....	80
11 " 0 "	2	81	....	83
11 " 3 "	....	85	....	85
11 " 6 "	....	85	2	87
12 " 0 "	....	85	5	90
12 " 6 "	....	85	8	93
13 " 0 "	....	85	11	96
13 " 6 "	....	85	14	99
14 " 0 "	....	85	17	102
14 " 6 "	....	85	21	106
15 " 0 "	....	85	24	109
15 " 6 "	....	85	27	112
16 " 0 "	....	85	30	115
16 " 6 "	....	85	33	118

TABLE OF 13½-INCH KEY BRICK
CONTINUED

Inside Diameter	No. 1 Key	Straight	Total
17 ft. 0 in.	85	36	121
17 " 6 "	85	39	124
18 " 0 "	85	43	128
18 " 6 "	85	46	131
19 " 0 "	85	49	134
19 " 6 "	85	52	137
20 " 0 "	85	55	140
20 " 6 "	85	58	143
21 " 0 "	85	61	146
21 " 6 "	85	65	150
22 " 0 "	85	68	153
22 " 6 "	85	71	156
23 " 0 "	85	74	159
23 " 6 "	85	77	162
24 " 0 "	85	80	165
24 " 6 "	85	83	168
25 " 0 "	85	87	172
25 " 6 "	85	90	175
26 " 0 "	85	93	178
26 " 6 "	85	96	181
27 " 0 "	85	99	184
27 " 6 "	85	102	187
28 " 0 "	85	105	190

TABLE OF 13½-INCH KEY BRICK
CONTINUED

Inside Diameter	No. 1 Key	Straight	Total
28 ft. 6 in.	85	109	194
29 " 0 "	85	112	197
29 " 6 "	85	115	200
30 " 0 "	85	118	203
30 " 6 "	85	121	206
31 " 0 "	85	124	209
31 " 6 "	85	127	212
32 " 0 "	85	131	216
32 " 6 "	85	134	219
33 " 0 "	85	137	222
33 " 6 "	85	140	225
34 " 0 "	85	143	228
34 " 6 "	85	146	231
35 " 0 "	85	149	234

TABLE OF 9X6X3-INCH KEY BRICK

Inside Diameter	No. 2 Key 9x6x4 $\frac{11}{16}$x3"	No. 1 Key 9x6x5⅜x3"	Squares	Total
6 ft. 0 in.	47	....	....	47
6 " 6 "	44	6	....	50
7 " 0 "	42	12	....	54
7 " 6 "	38	19	....	57
8 " 0 "	34	26	....	60
8 " 6 "	31	32	....	63
9 " 0 "	27	39	....	66
9 " 6 "	23	46	....	69
10 " 0 "	20	52	....	72
10 " 6 "	16	59	....	75

TABLE OF 9X6X3-INCH KEY BRICK
CONTINUED

Inside Diameter	No. 2 Key 9x6x4$\frac{11}{16}$x3"	No. 1 Key 9x6x5$\frac{3}{8}$x3"	Squares	Total
11 ft. 0 in.	13	66	....	79
11 " 6 "	10	72	....	82
12 " 0 "	6	79	....	85
12 " 6 "	3	85	....	88
13 " 0 "	....	91	....	91
13 " 6 "	....	91	3	94
14 " 0 "	....	91	6	97
14 " 6 "	....	91	10	101
15 " 0 "	....	91	13	104
15 " 6 "	....	91	16	107
16 " 0 "	....	91	19	110
16 " 6 "	....	91	22	113
17 " 0 "	....	91	25	116
17 " 6 "	....	91	28	119
18 " 0 "	....	91	32	123
18 " 6 "	....	91	35	126
19 " 0 "	....	91	38	129
19 " 6 "	....	91	41	132
20 " 0 "	....	91	44	135
20 " 6 "	....	91	47	138
21 " 0 "	....	91	50	141
21 " 6 "	....	91	54	145
22 " 0 "	....	91	57	148
22 " 6 "	....	91	60	151
23 " 0 "	....	91	63	154
23 " 6 "	....	91	66	157
24 " 0 "	....	91	69	160
24 " 6 "	....	91	72	163
25 " 0 "	....	91	76	167
25 " 6 "	....	91	79	170
26 " 0 "	....	91	82	173
26 " 6 "	....	91	85	176
27 " 0 "	....	91	88	179
27 " 6 "	....	91	91	182
28 " 0 "	....	91	94	185
28 " 6 "	....	91	98	189
29 " 0 "	....	91	101	192
29 " 6 "	....	91	104	195
30 " 0 "	....	91	107	198

TABLE OF GAS FLUE ARCH BRICK
FOR BLAST FURNACE DOWNCOMER

Inside Diameter Openings	Shapes Required			
	No. 3	No. 4	No. 5	Straight
2 ft. 9 in.	46			
3 ft. 0 in.	34	15		
3 ft. 6 in.	16	38		
4 ft. 0 in.		59		
4 ft. 6 in.		26	39	
5 ft. 0 in.			70	
5 ft. 6 in.			70	6
6 ft. 0 in.			70	11
6 ft. 6 in.			70	16
7 ft. 0 in.			70	22
7 ft. 6 in.			70	27
8 ft. 0 in.			70	32
8 ft. 6 in.			70	38
9 ft. 0 in.			70	43

CUPOLA BLOCKS

Inside Diameter Cupola Lining	Shapes Required			
	30-Inch	36-Inch	48-Inch	60-Inch
2 ft. 6 in.	15			
2 ft. 9 in.	8	8		
3 ft. 0 in.		17		
3 ft. 3 in.		12	6	
3 ft. 6 in.		8	11	
3 ft. 9 in.		4	16	
4 ft. 0 in.			21	
4 ft. 3 in.			15	7
4 ft. 6 in.			10	13
4 ft. 9 in.			5	19
5 ft. 0 in.				25

STANDARD BOTTOM BLOCKS

IN ONE COURSE OF FOLLOWING DIAMETERS

Blocks 18x12x8″		Blocks 18x9x4½″	
Diameter	No. Blocks	Diameter	No. Blocks
8′ 0″	89	8′ 0″	198
8′ 6″	99	8′ 6″	222
9′ 0″	110	9′ 0″	248
9′ 6″	122	9′ 6″	275
10′ 0″	134	10′ 0″	303
10′ 6″	147	10′ 6″	333
11′ 0″	161	11′ 0″	364
11′ 6″	175	11′ 6″	397
12′ 0″	189	12′ 0″	431
12′ 6″	204	12′ 6″	466
13′ 0″	220	13′ 0″	503
13′ 6″	237	13′ 6″	541
14′ 0″	254	14′ 0″	581
14′ 6″	271	14′ 6″	621
15′ 0″	289	15′ 0″	664
15′ 6″	308	15′ 6″	708
16′ 0″	327	16′ 0″	753
16′ 6″	347	16′ 6″	799
17′ 0″	368	17′ 0″	847
17′ 6″	389	17′ 6″	897
18′ 0″	411	18′ 0″	947
18′ 6″	433	18′ 6″	999
19′ 0″	456	19′ 0″	1053
19′ 6″	479	19′ 6″	1108
20′ 0″	503	20′ 0″	1164
20′ 6″	528	20′ 6″	1222
21′ 0″	554	21′ 0″	1281
21′ 6″	579	21′ 6″	1342
22′ 0″	605	22′ 0″	1403
22′ 6″	632	22′ 6″	1467
23′ 0″	660	23′ 0″	1531
23′ 6″	688	23′ 6″	1598
24′ 0″	717	24′ 0″	1665
24′ 6″	746	24′ 6″	1734
25′ 0″	776	25′ 0″	1804
25′ 6″	807	25′ 6″	1876

TABLE OF SILICA 12-INCH WEDGE BRICK

3-INCH SERIES

Inside Diameter	3″ No. 2 Wedge 12 x 6 x 3 x 2″	3″ No. 1 Wedge 12 x 6 x 3 x 2½″	Straight 12 x 6 x 3″	Total
4 ft. 0 in.	75	....	....	75
4 " 6 "	69	13	....	82
5 " 0 "	63	25	....	88
5 " 6 "	56	38	....	94
6 " 0 "	51	50	....	101
6 " 6 "	44	63	....	107
7 " 0 "	38	75	....	113
7 " 6 "	31	88	....	119
8 " 0 "	25	101	....	126
8 " 6 "	19	113	....	132
9 " 0 "	12	126	....	138
9 " 6 "	7	138	....	145
10 " 0 "	....	151	....	151
10 " 6 "	....	151	6	157
11 " 0 "	....	151	13	164
11 " 6 "	....	151	19	170
12 " 0 "	....	151	25	176
12 " 6 "	....	151	32	183
13 " 0 "	....	151	38	189
13 " 6 "	....	151	44	195
14 " 0 "	....	151	50	201
14 " 6 "	....	151	57	208
15 " 0 "	....	151	63	214
15 " 6 "	....	151	69	220
16 " 0 "	....	151	75	226
16 " 6 "	....	151	82	233
17 " 0 "	....	151	88	239
17 " 6 "	....	151	94	245
18 " 0 "	....	151	101	252
18 " 6 "	....	151	107	258
19 " 0 "	....	151	113	264
19 " 6 "	....	151	120	271
20 " 0 "	....	151	126	277
20 " 6 "	....	151	132	283
21 " 0 "	....	151	139	290
21 " 6 "	....	151	145	296
22 " 0 "	....	151	151	302

See pages 36 and 37 for 2½-inch series. In ordering state whether you desire 2½-inch or 3-inch series.

TABLE OF SILICA 12-INCH WEDGE BRICK

2½-INCH SERIES

Inside Diameter	2½″ No. 1 Wedge 12 x 6 x 2$\frac{11}{16}$ x 2½″	Straight 12 x 6 x 2½	Total
26 ft. 9 in.	404	....	404
27 " 0 "	404	4	408
27 " 6 "	404	11	415
28 " 0 "	404	19	423
28 " 6 "	404	27	431
29 " 0 "	404	34	438
29 " 6 "	404	42	446
30 " 0	404	49	453
30 " 6 "	404	57	461
31 " 0 "	404	64	468
31 " 6 "	404	71	475
32 " 0 "	404	79	483
32 " 6 "	404	87	491
33 " 0 "	404	94	498
33 " 6 "	404	102	506
34 " 0 "	404	109	513
34 " 6 "	404	117	521
35 " 0 "	404	125	529
35 " 6 "	404	132	536
36 " 0 "	404	140	544

See pages 35 and 36 for 3-inch series. In ordering state whether you desire 2½-inch or 3-inch series.

TABLE OF SILICA 12-INCH ARCH BRICK

Inside Diameter	12″ No. 2 Arch 12 x 6 x 2½ x 2″	12″ No. 1 Arch 12 x 6 x 3 x 2½″	Straights 12 x 6 x 2½″	Straights 12 x 6 x 3″
4 ft. 0 in.	75	....	....	....
4 " 6 "	75	7	....	....
5 " 0 "	....	75	....	....
5 " 6 "	....	75	8	6
6 " 0 "	....	75	15	12
6 " 6 "	....	75	23	18
7 " 0 "	....	75	30	25
7 " 6 "	....	75	38	31
8 " 0 "	....	75	45	37
8 " 6 "	....	75	53	43
9 " 0 "	....	75	60	50
9 " 6 "	....	75	68	56
10 " 0 "	....	75	75	62
10 " 6 "	....	75	83	68
11 " 0 "	....	75	90	75
11 " 6 "	....	75	98	81
12 " 0 "	....	75	105	87

TABLE FOR STANDARD CIRCLE BRICK

Inside Diameter	24-inch Circle	36-inch Circle	48-inch Circle	60-inch Circle	72-inch Circle	Total
2 ft. 0 in.	12	......	......	......	......	12
2 " 3 "	9	4	......	......	......	13
2 " 6 "	6	8	......	......	......	14
2 " 9 "	3	12	......	......	......	15
3 " 0 "	......	16	......	......	......	16
3 " 3 "	......	11	6	......	......	17
3 " 6 "	......	7	11	......	......	18
3 " 9 "	......	3	16	......	......	19
4 " 0 "	......	......	20	......	......	20
4 " 3 "	......	......	14	7	......	21
4 " 6 "	......	......	9	13	......	22
4 " 9 "	......	......	4	19	......	23
5 " 0 "	......	......	......	24	......	24
5 " 3 "	......	......	......	17	8	25
5 " 6 "	......	......	......	11	15	26
5 " 9 "	......	......	......	5	22	27
6 " 0 "	......	......	......	......	28	28

TEMPERATURES

Below we give the temperatures of iron, steel and other metals, under various conditions, according to the latest scientific investigations.

	Centigrade Degrees	Fahrenheit Degrees
Tin . . . . melts	229	445
Lead . . . . melts	322	612
Lead . . . . boils	1040	1904
Zinc . . . . melts	412	775
Zinc . . . . boils	1040	1904
Aluminum . . . . melts	700	1252
Silver . . . . melts	957	1775
Brass . . . . melts	1021	1870
Copper . . . . melts	1029	1885
Gold . . . . melts	1038	1900
Cobalt . . . . melts	1100	2012
Cast Iron, white . . . . melts	1135	2075
Cast Iron, gray . . . . . melts	1222	2230
Steel . . . . melts	1300	2372
Iron, wrought . . . . . . melts	1500	2732
Nickel . . . . melts	1500	2732
Platinum . . . . melts	2533	4593
Glass Furnace, between the pots.	1375	2507
In the pots, refining	1310	2390
In the pots, working	1045	1913
Tanks melted for casting	1310	2390
Annealing Glassware	444 to 555	800 to 1000
Siemens Crucible Steel Furnace varies from	1460 to 1590	2660 to 2894

TEMPERATURES—CONTINUED

	Centigrade Degrees	Fahrenheit Degrees
BESSEMER PROCESS		
Running the slag	1580	2876
Running steel into ladle	1640	2984
Running steel into mold	1580	2876
Soaking pit furnace, ingot in	1200	2192
Ingot under hammer	1080	1976
OPEN HEARTH PROCESS		
Gas from producers	720	1328
Gas entering generator	400	752
Gas leaving generator	1200	2192
Air leaving generator	1000	1832
Fumes passing to shaft	300	572
End of fusion of charge	1420	2588
Refining the steel	1500	2732
Running into ladle, first	1580	2876
Running into ladle, last	1490	2714
BLAST FURNACE—GRAY BESSEMER		
Front of tuyere	1930	3506
At tapping	1570	2858

The following table affords a somewhat rough method of estimating high temperatures.

	Centigrade Degrees	Fahrenheit Degrees
Just glowing in the dark	525	977
Dark red	700	1252
Cherry red	908	1666
Bright cherry red	1000	1832
Orange	1150	2102
White	1300	2372
Dazzling white	1500	2732

FUSING POINTS OF SEGER CONES

Number of Cone	Fusing Point		Number of Cone	Fusing Point	
	Degrees Fahr.	Degrees Centig.		Degrees Fahr.	Degrees Centig.
.022	1,094	590	10	2,426	1,330
.021	1,148	620	11	2,462	1,350
.020	1,202	650	12	2,498	1,370
.019	1,256	680	13	2,534	1,390
.018	1,310	710	14	2,570	1,410
.017	1,364	740	15	2,606	1,430
.016	1,418	770	16	2,642	1,450
.015	1,472	800	17	2,678	1,470
.014	1,526	830	18	2,714	1,490
.013	1,580	860	19	2,750	1,510
.012	1,634	890	20	2,786	1,530
.011	1,688	920	21	2,822	1,550
.010	1,742	950	22	2,858	1,570
.09	1,778	970	23	2,894	1,590
.08	1,814	990	24	2,930	1,610
.07	1,850	1,010	25	2,966	1,630
.06	1,886	1,030	26	3,002	1,650
.05	1,922	1,050	27	3,038	1,670
.04	1,958	1,070	28	3,074	1,690
.03	1,994	1,090	29	3,110	1,710
.02	2,030	1,110	30	3,146	1,730
.01	2,066	1,130	31	3,182	1,750
1	2,102	1,150	32	3,218	1,770
2	2,138	1,170	33	3,254	1,790
3	2,174	1,190	34	3,290	1,810
4	2,210	1,210	35	3,326	1,830
5	2,246	1,230	36	3,362	1,850
6	2,282	1,250	37	3,398	1,870
7	2,318	1,270	38	3,434	1,890
8	2,354	1,290	39	3,470	1,910
9	2,390	1,310			

COMPARISON OF CENTIGRADE AND FAHRENHEIT THERMOMETERS

Centi-grade	Fahren-heit	Centi-grade	Fahren-heit	Centi-grade	Fahren-heit
1815	3299	1770	3218	1725	3137
1814	3297.2	1769	3216.2	1724	3135.2
1813	3295.4	1768	3214.4	1723	3133.4
1812	3293.6	1767	3112.6	1722	3131.6
1811	3291.8	1766	3210.8	1721	3129.8
1810	3290	1765	3209	1720	3128
1809	3288.2	1764	3207.2	1719	3126.2
1808	3286.4	1763	3205.4	1718	3124.4
1807	3284.6	1762	3203.6	1717	3122.6
1806	3282.8	1761	3201.8	1716	3120.8
1805	3281	1760	3200	1715	3119
1804	3279.2	1759	3198.2	1714	3117.2
1803	3277.4	1758	3196.4	1713	3115.4
1802	3275.6	1757	3194.6	1712	3113.6
1801	3273.8	1756	3192.8	1711	3111.8
1800	3272	1755	3191	1710	3110
1799	3270.2	1754	3189.2	1709	3108.2
1798	3268.4	1753	3187.4	1708	3106.4
1797	3266.6	1752	3185.6	1707	3104.6
1796	3264.8	1751	3183.8	1706	3102.8
1795	3263	1750	3182	1705	3101
1794	3261.2	1749	3180.2	1704	3099.2
1793	3259.4	1748	3178.4	1703	3097.4
1792	3257.6	1747	3176.6	1702	3095.6
1791	3255.8	1746	3174.8	1701	3093.8
1790	3254	1745	3173	1700	3092
1789	3252.2	1744	3171.2	1699	3090.2
1788	3250.4	1743	3169.4	1698	3088.4
1787	3248.6	1742	3167.6	1697	3086.6
1786	3246.8	1741	3165.8	1696	3084.8
1785	3245	1740	3164	1695	3083
1784	3243.2	1739	3162.2	1694	3081.2
1783	3241.4	1738	3160.4	1693	3079.4
1782	3239.6	1737	3158.6	1692	3077.6
1781	3237.8	1736	3156.8	1691	3075.8
1780	3236	1735	3155	1690	3074
1779	3234.2	1734	3153.2	1689	3072.2
1778	3232.4	1733	3151.4	1688	3070.4
1777	3230.6	1732	3149.6	1687	3068.6
1776	3228.8	1731	3147.8	1686	3066.8
1775	3227	1730	3146	1685	3065
1774	3225.2	1729	3144.2	1684	3063.2
1773	3223.4	1728	3142.4	1683	3061.4
1772	3221.6	1727	3140.6	1682	3059.6
1771	3219.8	1726	3138.8	1681	3057.8

COMPARISON OF CENTIGRADE AND FAHRENHEIT THERMOMETERS—CONTINUED

Centigrade	Fahrenheit	Centigrade	Fahrenheit	Centigrade	Fahrenheit
1680	3056	1635	2975	1590	2894
1679	3054.2	1634	2973.2	1589	2892.2
1678	3052.4	1633	2971.4	1588	2890.4
1677	3050.6	1632	2969.6	1587	2888.6
1676	3048.8	1631	2967.8	1586	2886.8
1675	3047	1630	2966	1585	2885
1674	3045.2	1629	2964.2	1584	2883.2
1673	3043.4	1628	2962.4	1583	2881.4
1672	3041.6	1627	2960.6	1582	2879.6
1671	3039.8	1626	2958.8	1581	2877.8
1670	3038	1625	2957	1580	2876
1669	3036.2	1624	2955.2	1579	2874.2
1668	3034.4	1623	2953.4	1578	2872.4
1667	3032.6	1622	2951.6	1577	2870.6
1666	3030.8	1621	2949.8	1576	2868.8
1665	3029	1620	2948	1575	2867
1664	3027.2	1619	2946.2	1574	2865.2
1663	3025.4	1618	2944.4	1573	2863.4
1662	3023.6	1617	2942.6	1572	2861.6
1661	3021.8	1616	2940.8	1571	2859.8
1660	3020	1615	2939	1570	2858
1659	3018.2	1614	2937.2	1569	2856.2
1658	3016.4	1613	2935.4	1568	2854.4
1657	3014.6	1612	2933.6	1567	2852.6
1656	3012.8	1611	2931.8	1566	2850.8
1655	3011	1610	2930	1565	2849
1654	3009.2	1609	2928.2	1564	2847.2
1653	3007.4	1608	2926.4	1563	2845.4
1652	3005.6	1607	2924.6	1562	2843.6
1651	3003.8	1606	2922.8	1561	2841.8
1650	3002	1605	2921	1560	2840
1649	3000.2	1604	2919.2	1559	2838.2
1648	2998.4	1603	2917.4	1558	2836.4
1647	2996.6	1602	2915.6	1557	2834.6
1646	2994.8	1601	2913.8	1556	2832.8
1645	2993	1600	2912	1555	2831
1644	2991.2	1599	2910.2	1554	2829.2
1643	2989.4	1598	2908.4	1553	2827.4
1642	2987.6	1597	2906.6	1552	2825.6
1641	2985.8	1596	2904.8	1551	2823.8
1640	2984	1595	2903	1550	2822
1639	2982.2	1594	2901.2	1549	2820.2
1638	2980.4	1593	2899.4	1548	2818.4
1637	2978.6	1592	2897.6	1547	2816.6
1636	2976.8	1591	2895.8	1546	2814.8

COMPARISON OF CENTIGRADE AND FAHRENHEIT THERMOMETERS—CONTINUED

Centi-grade	Fahren-heit	Centi-grade	Fahren-heit	Centi-grade	Fahren-heit
1545	2813	1500	2732	1455	2651
1544	2811.2	1499	2730.2	1454	2649.2
1543	2809.4	1498	2728.4	1453	2647.4
1542	2807.6	1497	2726.6	1452	2645.6
1541	2805.8	1496	2724.8	1451	2643.8
1540	2804	1495	2723	1450	2642
1539	2802.2	1494	2721.2	1449	2640.2
1538	2800.4	1493	2719.4	1448	2638.4
1537	2798.6	1492	2717.6	1447	2636.6
1536	2796.8	1491	2715.8	1446	2634.8
1535	2795	1490	2714	1445	2633
1534	2793.2	1489	2712.2	1444	2631.2
1533	2791.4	1488	2710.4	1443	2629.4
1532	2789.6	1487	2708.6	1442	2627.6
1531	2787.8	1486	2706.8	1441	2625.8
1530	2785	1485	2705	1440	2624
1529	2784.2	1484	2703.2	1439	2622.2
1528	2782.4	1483	2701.4	1438	2620.4
1527	2780.6	1482	2699.6	1437	2618.6
1526	2778.8	1481	2697.8	1436	2616.8
1525	2777	1480	2696	1435	2615
1524	2775.2	1479	2694.2	1434	2613.2
1523	2773.4	1478	2692.4	1433	2611.4
1522	2771.6	1477	2690.6	1432	2609.6
1521	2769.8	1476	2688.8	1431	2607.8
1520	2768	1475	2687	1430	2606
1519	2766.2	1474	2685.2	1429	2604.2
1518	2764.4	1473	2683.4	1428	2602.4
1517	2762.6	1472	2681.6	1427	2600.6
1516	2760.8	1471	2679.8	1426	2598.8
1515	2759	1470	2678	1425	2597
1514	2757.2	1469	2676.2	1424	2595.2
1513	2755.4	1468	2674.4	1423	2593.4
1512	2753.6	1467	2672.6	1422	2591.6
1511	2751.8	1466	2670.8	1421	2589.8
1510	2750	1465	2669	1420	2588
1509	2748.2	1464	2667.2	1419	2586.2
1508	2746.4	1463	2665.4	1418	2584.4
1507	2744.6	1462	2663.6	1417	2582.6
1506	2742.8	1461	2661.8	1416	2580.8
1505	2741	1460	2660	1415	2579
1504	2739.2	1459	2658.2	1414	2577.2
1503	2737.4	1458	2656.4	1413	2575.4
1502	2735.6	1457	2654.6	1412	2573.6
1501	2733.8	1456	2652.8	1411	2571.8

COMPARISON OF CENTIGRADE AND FAHRENHEIT THERMOMETERS—CONTINUED

Centi-grade	Fahren-heit	Centi-grade	Fahren-heit	Centi-grade	Fahren-heit
1410	2570	1320	2408	870	1598
1409	2568.2	1310	2390	860	1580
1408	2566.4	1300	2372	850	1562
1407	2564.6	1290	2354	840	1544
1406	2562.8	1280	2336	830	1526
1405	2561	1270	2318	820	1508
1404	2559.2	1260	2300	810	1490
1403	2557.4	1250	2282	800	1472
1402	2555.6	1240	2264	790	1454
1401	2553.8	1230	2246	780	1436
1400	2552	1220	2228	770	1418
1399	2550.2	1210	2210	760	1400
1398	2548.4	1200	2192	750	1382
1397	2546.6	1190	2174	740	1364
1396	2544.8	1180	2156	730	1346
1395	2543	1170	2138	720	1328
1394	2541.2	1160	2120	710	1310
1393	2539.4	1150	2102	700	1292
1392	2537.6	1140	2084	690	1274
1391	2535.8	1130	2066	680	1256
1390	2534	1120	2048	670	1238
1389	2532.2	1110	2030	660	1220
1388	2530.4	1100	2012	650	1202
1387	2528.6	1090	1994	640	1184
1386	2526.8	1080	1976	630	1166
1385	2525	1070	1958	620	1148
1384	2523.2	1060	1940	610	1130
1383	2521.4	1050	1922	600	1112
1382	2519.6	1040	1904	590	1094
1381	2517.8	1030	1886	580	1076
1380	2516	1020	1868	570	1058
1379	2514.2	1010	1850	560	1040
1378	2512.4	1000	1832	550	1022
1377	2510.6	990	1814	540	1004
1376	2508.8	980	1796	530	986
1375	2507	970	1778	520	968
1374	2505.2	960	1760	510	950
1373	2503.4	950	1742	500	932
1372	2501.6	940	1724	490	914
1371	2499.8	930	1706	480	896
1370	2498	920	1688	470	878
1360	2480	910	1670	460	860
1350	2462	900	1652	450	842
1340	2444	890	1634	440	824
1330	2426	880	1616	430	806

Comparison of Centigrade and Fahrenheit Thermometers—Continued

Centigrade	Fahrenheit	Centigrade	Fahrenheit	Centigrade	Fahrenheit
420	788	220	428	20	68
410	770	210	410	10	50
400	752	200	392	0	32
390	734	190	374	1	30.2
380	716	180	356	2	28.4
370	698	170	338	3	26.6
360	680	160	320	4	24.8
350	662	150	302	5	23
340	644	140	284	6	21.2
330	626	130	266	7	19.4
320	608	120	248	8	17.6
310	590	110	230	9	15.8
300	572	100	212	10	14
290	554	90	194	11	12.2
280	536	80	176	12	10.4
270	518	70	158	13	8.6
260	500	60	140	14	6.8
250	482	50	122	15	5
240	464	40	104	16	3.2
230	446	30	86	17	1.4
				18	0.4

Zero in Centigrade is the freezing point of water.

To change degrees Centigrade to Fahrenheit, multiply by 9, divide by 5 and add 32.

To change degrees Fahrenheit to Centigrade, subtract 32, divide by 9 and multiply by 5.

CIRCUMFERENCES AND AREAS OF CIRCLES FROM 1-64 TO 50

Diam.	Circum.	Area	Diam.	Circum.	Area
1/64	.04909	.000192	4	12.5664	12.5664
1/32	.09818	.000767	4⅛	12.9591	13.3641
1/16	.19635	.003068	4¼	13.3518	14.1863
⅛	.3927	.012272	4⅜	13.7445	15.033
3/16	.589	.027612	4½	14.1372	15.9043
¼	.7854	.049087	4⅝	14.5299	16.8002
5/16	.98175	.076699	4¾	14.9226	17.7206
⅜	1.1781	.110447	4⅞	15.3153	18.6555
7/16	1.37445	.15033			
½	1.5708	.19635	5	15.708	19.635
9/16	1.76715	.248505	5⅛	16.1007	20.629
⅝	1.9635	.306796	5¼	16.4934	21.6476
11/16	2.15985	.371224	5⅜	16.8861	22.6907
¾	2.3562	.441787	5½	17.2788	23.7583
13/16	2.55255	.518487	5⅝	17.6715	24.8505
⅞	2.7489	.601322	5¾	18.0642	25.9673
15/16	2.94525	.690292	5⅞	18.4569	27.1086
1	3.1416	.7854	6	18.8496	28.2744
1⅛	3.5343	.99402	6⅛	19.2423	29.4648
1¼	3.927	1.2272	6¼	19.635	30.6797
1⅜	4.3197	1.4849	6⅜	20.0277	31.9191
1½	4.7124	1.7671	6½	20.4204	33.1831
1⅝	5.1051	2.0739	6⅝	20.8131	34.4717
1¾	5.4978	2.4053	6¾	21.2058	35.7848
1⅞	5.8905	2.7612	6⅞	21.5985	37.1224
2	6.2832	3.1416	7	21.9912	38.4846
2⅛	6.6759	3.5466	7⅛	22.3839	39.8713
2¼	7.0686	3.9761	7¼	22.7766	41.2826
2⅜	7.4613	4.4301	7⅜	23.1693	42.7184
2½	7.854	4.9087	7½	23.562	44.1787
2⅝	8.2467	5.4119	7⅝	23.9547	45.6636
2¾	8.6394	5.9396	7¾	24.3474	47.1731
2⅞	9.0321	6.4918	7⅞	24.7401	48.7071
3	9.4248	7.0686	8	25.1328	50.2656
3⅛	9.8175	7.6699	8⅛	25.5255	51.8487
3¼	10.2102	8.2958	8¼	25.9182	53.4563
3⅜	10.6029	8.9462	8⅜	26.3109	55.0884
3½	10.9956	9.6211	8½	26.7036	56.7451
3⅝	11.3883	10.3206	8⅝	27.0963	58.4264
3¾	11.781	11.0447	8¾	27.489	60.1322
3⅞	12.1737	11.7933	8⅞	27.8817	61.8625

CIRCUMFERENCES AND AREAS OF CIRCLES
CONTINUED

Diam.	Circum.	Area	Diam.	Circum.	Area
9	28.2744	63.6174	15	47.124	176.715
9⅛	28.6671	65.3968	15⅛	47.5167	179.673
9¼	29.0598	67.2008	15¼	47.9094	182.655
9⅜	29.4525	69.0293	15⅜	48.3021	185.661
9½	29.8452	70.8823	15½	48.6948	188.692
9⅝	30.2379	72.7599	15⅝	49.0875	191.748
9¾	30.6306	74.6621	15¾	49.4802	194.828
9⅞	31.0233	76.5888	15⅞	49.8729	197.933
10	31.416	78.54	16	50.2656	201.062
10⅛	31.8087	80.5158	16⅛	50.6583	204.216
10¼	32.2014	82.5161	16¼	51.051	207.395
10⅜	32.5941	84.5409	16⅜	51.4437	210.598
10½	32.9868	86.5903	16½	51.8364	213.825
10⅝	33.3795	88.6643	16⅝	52.2291	217.077
10¾	33.7722	90.7628	16¾	52.6218	220.354
10⅞	34.1649	92.8858	16⅞	53.0145	223.655
11	34.5576	95.0334	17	53.4072	226.981
11⅛	34.9503	97.2055	17⅛	53.7999	230.331
11¼	35.343	99.4022	17¼	54.1926	233.906
11⅜	35.7357	101.6234	17⅜	54.5853	237.105
11½	36.1284	103.8691	17½	54.978	240.529
11⅝	36.5211	106.1394	17⅝	55.3707	243.977
11¾	36.9138	108.4343	17¾	55.7634	247.45
11⅞	37.3065	110.7537	17⅞	56.1561	250.948
12	37.6992	113.098	18	56.5488	254.47
12⅛	38.0919	115.466	18⅛	56.9415	258.016
12¼	38.4846	117.859	18¼	57.3342	261.587
12⅜	38.8773	120.277	18⅜	57.7269	265.183
12½	39.27	122.719	18½	58.1196	268.803
12⅝	39.6627	125.185	18⅝	58.5123	272.448
12¾	40.0554	127.677	18¾	58.905	276.117
12⅞	40.4481	130.192	18⅞	59.2977	279.811
13	40.8408	132.733	19	59.6904	283.529
13⅛	41.2335	135.297	19⅛	60.0831	287.272
13¼	41.6262	137.887	19¼	60.4758	291.04
13⅜	42.0189	140.501	19⅜	60.8685	294.832
13½	42.4116	143.139	19½	61.2612	298.648
13⅝	42.8043	145.802	19⅝	61.6539	302.489
13¾	43.197	148.49	19¾	62.0466	306.355
13⅞	43.5897	151.202	19⅞	62.4393	310.245
14	43.9824	153.938	20	62.832	314.16
14⅛	44.3751	156.7	20⅛	63.2247	318.099
14¼	44.7678	159.485	20¼	63.6174	322.063
14⅜	45.1605	162.296	20⅜	64.0101	326.051
14½	45.5532	165.13	20½	64.4028	330.064
14⅝	45.9459	167.99	20⅝	64.7955	334.102
14¾	46.3386	170.874	20¾	65.1882	338.164
14⅞	46.7313	173.782	20⅞	65.5809	342.25

CIRCUMFERENCES AND AREAS OF CIRCLES
CONTINUED

Diam.	Circum.	Area	Diam.	Circum.	Area
21	65.9736	346.361	27	84.8232	572.557
21⅛	66.3663	350.497	27⅛	85.2159	577.87
21¼	66.759	354.657	27¼	85.6086	583.209
21⅜	67.1517	358.842	27⅜	86.0013	588.571
21½	67.5444	363.051	27½	86.394	593.959
21⅝	67.9379	367.285	27⅝	86.7867	599.371
21¾	68.3298	371.543	27¾	87.1794	604.807
21⅞	68.7225	375.826	27⅞	87.5729	610.268
22	69.1152	380.134	28	87.9648	615.754
22⅛	69.5079	384.466	28⅛	88.3575	621.264
22¼	69.9006	388.822	28¼	88.7502	626.798
22⅜	70.2933	393.203	28⅜	89.1429	632.357
22½	70.686	397.609	28½	89.5356	637.941
22⅝	71.0787	402.038	28⅝	89.9283	643.549
22¾	71.4714	406.494	28¾	90.321	649.182
22⅞	71.8641	410.973	28⅞	90.7137	654.84
23	72.2568	415.477	29	91.1064	660.521
23⅛	72.6495	420.004	29⅛	91.4991	666.228
23¼	73.0422	424.558	29¼	91.8918	671.959
23⅜	73.4349	429.135	29⅜	92.2845	677.714
23½	73.8276	433.737	29½	92.6772	683.494
23⅝	74.2203	438.364	29⅝	93.0699	689.299
23¾	74.613	443.015	29¾	93.4626	695.128
23⅞	75.0057	447.69	29⅞	93.8553	700.982
24	75.3984	452.39	30	94.248	706.86
24⅛	75.7911	457.115	30⅛	94.6407	712.763
24¼	76.1838	461.864	30¼	95.0334	718.69
24⅜	76.5765	466.638	30⅜	95.4261	724.642
24½	76.9692	471.436	30½	95.8188	730.618
24⅝	77.3619	476.259	30⅝	96.2115	736.619
24¾	77.7546	481.107	30¾	96.6042	742.645
24⅞	78.1473	485.979	30⅞	96.9969	748.695
25	78.54	490.875	31	97.3896	754.769
25⅛	78.9327	495.796	31⅛	97.7823	760.869
25¼	79.9254	500.742	31¼	98.175	766.992
25⅜	79.7181	505.712	31⅜	98.5677	773.14
25½	80.1108	510.706	31½	98.9604	779.313
25⅝	80.5035	515.726	31⅝	99.3531	785.51
25¾	80.8962	520.769	31¾	99.7458	791.732
25⅞	81.4889	525.838	31⅞	100.1385	797.979
26	81.6816	530.93	32	100.5312	804.25
26⅛	82.0743	536.048	32⅛	100.9239	810.545
26¼	82.476	541.19	32¼	101.3166	816.865
26⅜	82.8597	546.356	32⅜	101.7093	823.21
26½	83.2524	551.547	32½	102.102	829.579
26⅝	83.6451	556.763	32⅝	102.4947	835.972
26¾	84.0378	562.003	32¾	102.8874	842.391
26⅞	84.4305	567.267	32⅞	103.2801	848.833

CIRCUMFERENCES AND AREAS OF CIRCLES
CONTINUED

Diam.	Circum.	Area	Diam.	Circum.	Area
33	103.673	855.301	39	122.522	1194.593
33⅛	104.065	861.792	39⅛	122.915	1202.263
33¼	104.458	868.309	39¼	123.308	1209.958
33⅜	104.851	874.85	39⅜	123.7	1217.677
33½	105.344	881.415	39½	124.093	1225.42
33⅝	105.636	888.005	39⅝	124.486	1233.188
33¾	106.029	894.62	39¾	124.879	1240.981
33⅞	106.422	901.259	39⅞	125.271	1248.798
34	106.814	907.922	40	125.664	1256.64
34⅛	107.207	914.611	40⅛	126.057	1264.51
34¼	107.6	921.323	40¼	126.449	1272.4
34⅜	107.992	928.061	40⅜	126.842	1280.31
34½	108.385	934.822	40½	127.235	1288.25
34⅝	108.778	941.609	40⅝	127.627	1296.22
34¾	109.171	948.42	40¾	128.02	1304.21
34⅞	109.563	955.255	40⅞	128.413	1312.22
35	109.956	962.115	41	128.806	1320.26
35⅛	110.349	969.	41⅛	129.198	1328.32
35¼	110.741	975.909	41¼	129.591	1336.41
35⅜	111.134	982.842	41⅜	129.984	1344.52
35½	111.527	989.8	41½	130.376	1352.66
35⅝	111.919	996.783	41⅝	130.769	1360.82
35¾	112.312	1003.79	41¾	131.162	1369.
35⅞	112.705	1010.822	41⅞	131.554	1377.21
36	113.098	1017.878	42	131.947	1385.45
36⅛	113.49	1024.96	42⅛	132.34	1393.7
36¼	113.883	1032.065	42¼	132.733	1401.99
36⅜	114.276	1039.195	42⅜	133.125	1410.3
36½	114.668	1046.349	42½	133.518	1418.63
36⅝	115.061	1053.528	42⅝	133.911	1426.99
36¾	115.454	1060.732	42¾	134.303	1435.37
36⅞	115.846	1067.96	42⅞	134.696	1443.77
37	116.239	1075.213	43	135.089	1452.2
37⅛	116.632	1082.49	43⅛	135.481	1460.66
37¼	117.025	1089.792	43¼	135.874	1469.14
37⅜	117.417	1097.118	43⅜	136.267	1477.64
37½	117.81	1104.469	43½	136.66	1486.17
37⅝	118.203	1111.844	43⅝	137.052	1494.73
37¾	118.595	1119.244	43¾	137.445	1503.3
37⅞	118.988	1126.669	43⅞	137.838	1511.91
38	119.381	1134.118	44	138.23	1520.53
38⅛	119.773	1141.591	44⅛	138.623	1529.19
38¼	120.166	1149.089	44¼	139.016	1537.86
38⅜	120.559	1156.612	44⅜	139.408	1546.56
38½	120.952	1164.159	44½	139.801	1555.29
38⅝	121.344	1171.731	44⅝	140.194	1564.04
38¾	121.737	1179.327	44¾	140.587	1572.81
38⅞	122.13	1186.948	44⅞	140.979	1581.61

CIRCUMFERENCES AND AREAS OF CIRCLES
CONTINUED

Diam.	Circum.	Area
45	141.372	1590.43
45⅛	141.765	1599.28
45¼	142.157	1608.16
45⅜	142.55	1617.05
45½	142.943	1625.97
45⅝	143.335	1634.92
45¾	143.728	1643.89
45⅞	144.121	1652.89
46	144.514	1661.91
46⅛	144.906	1670.95
46¼	145.299	1680.02
46⅜	145.692	1689.11
46½	146.084	1698.23
46⅝	146.477	1707.37
46¾	146.87	1716.54
46⅞	147.262	1725.73
47	147.655	1734.95
47⅛	148.048	1744.19
47¼	148.441	1753.45
47⅜	148.833	1762.74
47½	149.226	1772.06
47⅝	149.619	1781.4
47¾	150.011	1790.76
47⅞	150.404	1800.15
48	150.797	1809.56
48⅛	151.189	1819.
48¼	151.582	1828.46
48⅜	151.975	1837.95
48½	152.368	1847.46
48⅝	152.76	1856.99
48¾	153.153	1866.55
48⅞	153.546	1876.14
49	153.938	1885.75
49⅛	154.331	1895.38
49¼	154.724	1905.04
49⅜	155.116	1914.72
49½	155.509	1924.43
49⅝	155.902	1934.16
49¾	156.295	1943.91
49⅞	156.687	1953.69
50	157.08	1963.5

Diam.	Circum.	Area
51	160.22	2042.82
52	163.36	2123.71
53	166.50	2206.18
54	169.65	2290.21
55	172.79	2375.82
56	175.93	2463.01
57	179.07	2551.75
58	182.21	2642.08
59	185.35	2733.97
60	188.50	2827.43
61	191.64	2922.46
62	194.78	3019.07
63	197.92	3117.24
64	201.06	3216.99
65	204.20	3318.30
66	207.35	3421.18
67	210.49	3525.65
68	213.63	3631.68
69	216.77	3739.28
70	219.91	3848.45
71	223.05	3959.19
72	226.19	4071.50
73	229.34	4185.38
74	232.48	4300.84
75	235.62	4417.86
76	238.76	4536.45
77	241.90	4656.62
78	245.04	4778.36
79	248.19	4901.66
80	251.33	5026.54
81	254.47	5153.00
82	257.61	5281.01
83	260.75	5410.59
84	263.89	5541.77
85	267.04	5674.50
86	270.18	5808.80
87	273.32	5944.67
88	276.46	6082.11
89	279.60	6221.13
90	282.74	6361.72
91	285.88	6503.87
92	289.03	6647.61
93	292.17	6792.90
94	295.31	6939.78
95	298.45	7088.21
96	301.59	7238.23
97	304.73	7389.81
98	307.88	7542.96
99	311.02	7697.68
100	314.16	7853.97

TABLE FOR CIRCLE BRICK

FOR LENGTH OF CHORD MULTIPLY SINE BY DIAMETER

No. to Circle	Sine of Half Angle	Diameter for 9″ Chord	No. to Circle	Sine of Half Angle	Diameter for 9″ Chord
5	.58779	15.311″	28	.11196	80.385″
6	.50000	18.000″	29	.10811	83.248″
7	.43386	20.740″	30	.10453	86.099″
8	.38268	23.518″	31	.10044	89.605″
9	.34202	26.314″	32	.09802	91.818″
10	.30902	29.124″	33	.09507	94.667″
11	.28173	31.945″	34	.09225	97.560″
12	.25882	34.773″	35	.08965	100.390″
13	.23932	37.606″	36	.08716	103.257″
14	.22251	40.447″	37	.08481	106.119″
15	.20791	43.287″	38	.08258	108.985″
16	.19509	46.132″	39	.08046	111.856″
17	.18428	48.833″	40	.07846	114.708″
18	.17365	51.828″	41	.07655	117.570″
19	.16459	54.681″	42	.07472	120.449″
20	.15643	57.533″	43	.07300	123.287″
21	.14904	60.386″	44	.07136	127.102″
22	.14230	63.246″	45	.06976	129.014″
23	.13617	66.094″	46	.06825	131.868″
24	.13053	68.949″	47	.06679	134.750″
25	.12534	71.805″	48	.06540	137.614″
26	.12054	74.664″	49	.06407	140.471″
27	.11609	77.526″	50	.06279	143.334″

WEIGHTS OF VARIOUS MATERIALS

Material	Average Per Cu. Ft. Pounds
BRICK	
Common red	100
Fire clay	150
Silica	128
Chrome	175
Magnesia as brick or fused in furnace	160
CEMENT	
Portland	78
Hydraulic	60
FINE GROUND CLAYS, SILICA CEMENT, ETC.	
Fire clay	85
Silica cement	75
Magnesia cement	127
Chrome cement	135
Grain magnesite (as shipped)	112
COAL AND COKE	
Anthracite	60
Bituminous	49
Charcoal	18.5
Coke	26.3
CONCRETE	
Cement, fine	137
Rubble, coarse	119
EARTH	
Loam, dry, loose	76
Loam, packed	95
Loam, soft, loose mud	108
Loam, dense mud	125
GLASS	
Common window	157
Plate	172
Flint	192
Floor or skylight	158
GRAIN	
Corn	45
Oats	24
Wheat	48
LIME	
Quick, loose lumps	53
Quick, fine	75
Stone, large rocks	168
Stone, irregular lumps	96
MASONRY	
Granite or limestone	165
Mortar, rubble	154
Dry	138
Sandstone, dressed	144
METALS	
Aluminum	166
Brass, cast	524
Bronze	534
Copper, cast	537
Copper, rolled or wire	555
Iron, cast	450
Iron, wrought	482

WEIGHTS OF VARIOUS MATERIALS
CONTINUED

Material	Average Per Cu. Ft. Pounds
METALS—Continued	
Lead, cast	708
Lead, rolled	711
Steel, cast	490
Steel, rolled	495
Tin, cast	459
Zinc, cast	438
OILS	
Engine	55
Crude	48
Petroleum	55
Gasoline	43
ROCK	
Chalk	145
Granite	165
Gypsum	143
Sandstone	144
Pumice stone	57
Quartz	165
Salt, coarse	45
Salt, fine	49
Shales	162
Slate, American	175
SAND	
Dry and loose	100
Dry and packed	110
Wet and packed	130
Gravel packed	118
WATER	
Water as ice	58.7
Water at 32 degrees Fahrenheit	62.4
Water at 212 degrees Fahrenheit	59.6
WOODS, DRY	
Apple	48
Beech	43
Birch	45
Cedar, American	35
Chestnut	41
Ebony	76
Elm	35
Hemlock	25
Hickory	53
Ironwood	114
Mahogany	35 to 53
Maple	49
Oak, live	59
Oak, white	50
Pine, white	25
Pine, yellow northern	34
Pine, yellow southern	45
Spruce	25
Walnut	35

Decimals of an Inch for Each 1-64th

1-64	.015625	33-64	.515625
1-32	.03125	17-32	.53125
3-64	.046875	35-64	.546875
1-16	.0625	9-16	.5625
5-64	.078125	37-64	.578125
3-32	.09375	19-32	.59375
7-64	.109375	39-64	.609375
1-8	.125	5-8	.625
9-64	.140625	41-64	.640625
5-32	.15625	21-32	.65625
11-64	.171875	43-64	.671875
3-16	.1875	11-16	.6875
13-64	.203125	45-64	.703125
7-32	.21875	23-32	.71875
15-64	.234375	47-64	.734375
1-4	.250	3-4	.75
17-64	.265625	49-64	.765625
9-32	.28125	25-32	.78125
19-64	.296875	51-64	.796875
5-16	.3125	13-16	.8125
21-64	.328125	53-64	.828125
11-32	.34375	27-32	.84375
23-64	.359375	55-64	.859375
3-8	.375	7-8	.875
25-64	.390625	57-64	.890625
13-32	.40625	29-32	.90625
27-64	.421875	59-64	.921875
7-16	.4375	15-16	.9375
29-64	.453125	61-64	.953125
15-32	.46875	31-32	.96875
31-64	.484375	63-64	.984375
1-2	.500	1	1.

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STANDARD AND SPECIAL SHAPES ILLUSTRATIONS OF

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The Caxton Company
Cleveland

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[illegible]6 / 366 / 42 / 4 / 10

[illegible]

Buffalo 32 [illegible]

Montreal

City of Montreal

City

2 3